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REPORT

ON THE

DANISH OCEANOGRAPHICAL EXPEDITIONS 1908-1910

TO THE

MEDITERRANEAN AND ADJACENT SEAS

PUBLISHED AT THE COST OF THE CARLSBERG FUND

UNDER THE SUPERINTENDENCE OF

JOHS. SCHMIDT, PH. D.
DIRECTOR OF THE CARLSBERG PHYSIOLOGICAL LABORATORY, COPENHAGEN,
MEMBER OF THE DANISH COMMITTEE FOR THE STUDY OF THE SEA,
LEADER OF THE EXPEDITIONS

N° 8

VOL. II (Biology), A. 11: Scombriformes by E. EHRENBAUM.
— - — D. 4: Hyperiidea-Amphipoda (part 2) by K. STEPHENSEN.
— - — H. 1: Medusæ by P. KRAMP.
— - — J. 3: Mediterranean Tintinnidæ by E. JÖRGENSEN.

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ANDR. FRED. HØST & SØN
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List of Papers resulting in whole or in part from the Cruises of the Danish Research-Steamer "Thor" in the Atlantic and Mediterranean.

1. Hydrography.

J. P. JACOBSEN, in Schmidt, Nielsen og Jacobsen: Fra den danske oceanografiske Expedition til Middelhavet i Vinteren 1908—1909. (Geografisk Tidsskrift, 20. H. VI, København 1910).

MARTIN KNUDSEN: Danish Hydrographical Investigations at the Faroe Islands in the Spring of 1910. (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Hydrografi, II, No. 1, København 1911.

J. N. NIELSEN: Hydrography of the Waters by the Faroe Islands and Iceland during the cruises of the Danish research-steamer "Thor" in the summer 1903 (ibid. I, No. 4, 1904).

— Contributions to the Hydrography of the Waters north of Iceland (ibid. I, No. 7, 1905).

— Contribution to the Hydrography of the north-eastern part of the Atlantic Ocean (ibid. I, No. 9, 1907).

— Contribution to the understanding of the currents in the northern part of the Atlantic Ocean (ibid. I, No. 11, 1908).

— in Schmidt, Nielsen og Jacobsen: Fra den danske oceanografiske Expedition til Middelhavet i Vinteren 1908—1909 (Geografisk Tidsskrift, 20, H. VI, København 1910).

— Sur les températures des grandes profondeurs particulièrement dans la Méditerranée, Note préliminaire, (Bulletin de l'Institut Océanographique, No. 209, Monaco 1911).

— Hydrografiske Undersøgelser i Middelhavet; De danske oceanografiske Expeditioner i 1908—1910, København 1913.

Numerous observations, sections, etc. from the "Thor" Expeditions in the Atlantic have been published in: Bulletin Hydrographique du Conseil Permanent International pour l'Exploration de la Mer, København 1902 and following years.

2. Biology.

VILH. EGE On the postlarval stages of the species of *Paralepis* inhabiting the North Eastern part of the Atlantic incl. the Mediterranean (Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Vol. 69, København 1918).

P. JESPERSEN: Contributions to the Life-History of the North Atlantic Halibut (*Hippoglossus vulgaris* Flem.) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, Bind V, No. 5, København 1917).

— On the Occurrence of the Postlarval Stages of the Herring and the "Lodde" (*Clupea harengus* L, and *Mallotus villosus* O. F. M.) at Iceland and the Færoes, (ibid. Bind VI, No. 1, 1920).

P. JESPERSEN and Å. VEDEL TÅNING: Some Mediterranean and Atlantic Sternoptychidae. (Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Vol. 70, København 1919).

C. H. OSTENFELD: *Thorosphaera*, eine neue Gattung der Coccolithophoriden (Berichte der deutschen Botanischen Gesellschaft, Bd. 28, Berlin 1910).

OVE PAULSEN: Plankton-Investigations in the Waters round Iceland in 1903 (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Plankton, I, No. 1, København 1904).

— On some Peridineae and Planktons Diatoms (ibid. I, No. 3, 1905).

— Studies on the biology of *Calanus finmarchicus* in the waters round Iceland (ibid. I, No. 4, 1906).

— Plankton Investigations in the Waters round Iceland and in the North Atlantic in 1904 (ibid. I, No. 8, 1909).

— The plankton on a submarine bank (in Biologiske Arbejder tilegnede Eug. Warming d. 3. Nov. 1911, København 1911).

C. G. JOH. PETERSEN: On the Larval and Postlarval Stages of the Long Rough Dab and the Genus *Pleuronectes* (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, I, No. 1, København 1904).

C. G. JOH. PETERSEN: Larval Eels *(Leptocephalus brevirostris)* of the Atlantic Coasts of Europe (ibid. I, No. 5, 1905).

— On the young stages of the Genus *Zeugopterus* (Report of the Danish Biological Station, XII, København 1905).

— On the Larval and Post-Larval Stages of some *Pleuronectidae (Pleuronectes, Zeugopterus)* (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, II, No. 1, København 1906).

— On the Larval and Postlarval Stages of some *Pleuronectidae (Zeugopterus, Arnoglossus, Solea)* (ibid. III. No. 1, 1909).

LOUIS ROULE: Étude sur les formes larvaires Tiluriennes de Poissons Apodes recueillies par le "Thor" (Annales de l'Institut Océanographique, T. VI, Fasc. 2, Monaco 1913).

JOHS. SCHMIDT: Fiskeriundersøgelser ved Island og Færøerne i Sommeren 1903 (Skrifter udgivne af Kommissionen for Havundersøgelser, No. 1. København 1904).

— On Pelagic Post-Larval Halibut *(Hippoglossus vulgaris* Flem. and *H. hippoglossoïdes* [Walb.]) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, I, No. 3, København 1904).

— The Pelagic Post-Larval Stages of the Atlantic Species of *Gadus*, Part I (ibid. I, No. 4, 1905).

— On the Larval and Post-Larval Stages of the Torsk (*Brosmius brosme* [Ascan.]) (ibid. I, No. 8. 1905).

— The Pelagic Post-Larval Stages of the Atlantic Species of *Gadus*, Part II, (ibid. II, No. 2, 1906).

— On the Pelagic Post-Larval Stages of the Lings (*Molva molva* [Linné] and *Molva byrkelange* [Walb.]) (ibid. II, No. 3, 1906).

— On the Larval and Post-Larval Development of the Argentines (*Argentina silus* [Ascan.] and *Argentina sphyræna* Linné with notes on *Mallotus villosus* [O. F. Müll.]) (ibid. II, No. 4, 1906).

— Contribution to the Life-History of the Eel (*Anguilla vulgaris* Turt.) (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. V, No. 4, København 1906).

— Marking Experiments on Plaice and Cod in Icelandic Waters (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, II, No. 6, København 1907).

— On the Post-Larval Development of the Hake (*Merluccius vulgaris* Flem.) (ibid. II, No. 7, 1907).

— On the Post-Larval Development of some North Atlantic Gadoids (*Raniceps raninus* [Linné] and *Molva elongata* [Risso]) (ibid. II, No. 8, 1907).

— On the Post-Larval Stages of the John Dory (*Zeus faber* L.) and some other Acanthopterygian Fishes (ibid. II, No. 9. 1908).

— Remarks on the Metamorphosis and Distribution of the Larvae of the Eel (*Anguilla vulgaris* Turt.) (ibid. III, No. 3, 1909).

— On the Occurrence of Leptocephali (Larval Muraenoids) in the Atlantic W. of Europe (ibid. III, No. 6, 1909.

— On the Distribution of the Fresh-Water Eels (*Anguilla*) throughout the World, I. Atlantic Ocean and Adjacent Regions (ibid. III, No. 7, 1909).

— The Distribution of the Pelagic Fry and the Spawning Regions of the Gadoids in the North Atlantic from Iceland to Spain (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. X, No. 4, København 1909).

— Exposé sommaire des travaux de l'expédition océanographique danoise dans la Méditerranée (1908—1909) (La Géographie, XXI, 2, Paris 1910).

— Leptocephalus hyoproroïdes and Lept. thorianus (Zoologischer Anzeiger, XXXVI, No. 2—3, Leipzig 1910).

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A. 11.

Scombriformes.

By

E. Ehrenbaum.

INHALTSVERZEICHNIS.

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EINLEITUNG.

Das in gegenwärtiger Arbeit berücksichtigte Material von Scombriden Larven stammt zum größten Teil aus den Fängen, welche Johs. Schmidt selbst an Bord des »Thor« im Mittelmeer in der Zeit von Mitte Dezember 1908 bis Ende Februar 1909 und Ende Juni bis Anfang September 1910 gemacht hat, zum kleineren Teil aus Fängen, welche im Auftrage von Johs. Schmidt von den Kapitänen gewisser dänischer Routendampfer im Mittelmeer und im Atlantik ausgeführt wurden[1].

Das bei allen diesen Fängen benutzte Netz ist das Jungfischtrawl (dän. Yngeltrawl), meist in den üblichen Abmessungen, und die Angabe der benutzten Leinenlänge läßt einen Schluß auf die Tiefe, in der das Netz gefischt hat, insofern zu, als bei der gewöhnlichen Schleppgeschwindigkeit von 2 Ml. in der Stunde, die Tiefe, in der das Netz steht, etwa gleich der halben Länge der Leine angenommen werden kann.

Obgleich das zu meiner Verfügung gestellte Material in seiner Gesamtheit die Ausbeute früherer Expeditionen weit in den Schatten stellt, so ist es leider doch noch nicht ausreichend, um eine durchweg einwandfreie Zurückführung der einzelnen Larven auf bestimmte Stammformen zu gestatten, und in vielen Punkten lassen infolge dessen die nachfolgenden Ausführungen diejenige Bestimmtheit und Sicherheit vermissen, die man von einer abgeschlossenen wissenschaftlichen Arbeit erwarten darf. Dennoch schien es ratsam, die Veröffentlichung nicht weiter hinauszuschieben, weil einesteils der Urheber der Sammlungen ein Anrecht darauf hat, daß sein wertvolles und in vieler Beziehung einzigartiges Material der wissenschaftlichen Welt nicht länger vorenthalten wird, und weil andererseits unsere Kenntnis von den Entwicklungsformen der Scombriden, und namentlich auch der vielen wirtschaftlich wichtigen Formen unter ihnen, eine so außerordentlich geringe ist, daß die Mitteilung jeglicher Daten, selbst wenn sie nicht ganz vollständig und zweifelsfrei sind, einen Gewinn bedeutet — zumal der im Mittelmeer arbeitende Zweig der Internationalen Meeresforschung neuerdings immer wieder betont hat, daß die Aufklärung der Biologie des Thuns und seiner Verwandten zu den vornehmsten Desideraten der fischereiwissenschaftlichen Forschung gehöre und mit allen verfügbaren Mitteln betrieben werden müsse.

Es bedarf indessen noch einer weiteren Erklärung, weshalb die zweifelsfreie Zuweisung der beobachteten Larven in vielen Fällen nicht gelungen ist.

Obwohl die Larven der Scombriden und besonders der Thynniden sich durch außerordentliche Kleinheit auszeichnen, so ist es doch auffallend, daß unter dem gesamten Material Larven von mehr als 10 oder 11 mm Länge zu den Seltenheiten gehören und solche von 15 mm[2] überhaupt nicht vertreten sind, sodaß es in vielen Fällen nicht möglich war, die Entwicklung der einzelnen Formen genügend weit zu verfolgen, um ihre Zugehörigkeit sicher feststellen zu können.

[1] Für die genaue Lage der Fangstationen sowie die Begleitumstände der einzelnen Fänge vergleiche man: Report on the Danish Oceanographical Expeditions 1908—1910, vol. I, p. 25—49 (1912) und Meddelelser fra Kommissionen for Havundersøgelser. Serie Fiskeri, Bd. V, Nr. 7, (1919).

[2] Diese sowie alle nachfolgenden Längenangaben beziehen sich auf Balsampraeparate; durch Vermehrung um 10 bis 15% erhält man die Längen der frischen oder in Formalin konservierten Formen.

Das hängt offenbar damit zusammen, daß die makrelenartigen Fische schon frühzeitig eine ganz außerordentliche Gewandtheit und Schnelligkeit der Bewegung besitzen, die ihnen erlaubt, Fanggeräten aller Art auszuweichen, selbst wenn dieselben so vorzügliche Fangeigenschaften besitzen wie das Jungfischtrawl.

Auf die Weise erklärt sich, daß man früher solche Larven überhaupt nicht und auch jetzt mit den verbesserten Hilfsmitteln nur in geringer Zahl zu fangen vermochte. Erst in neuerer Zeit hat man die Erfahrung gemacht, daß es bisweilen gelingt, bei ruhigem Wetter des nachts mit Hilfe kräftiger Lampen die Scombriden-Larven an der Oberfläche zu fangen.

Erschwerend fiel ferner ins Gewicht, daß die Jahreszeit, in der die Hauptmenge der Fänge gemacht wurde, für die Laichzeit der meisten Scombriden zu spät war, da die Frühjahrs- und Sommermonate, die in dieser Beziehung günstiger gewesen wären, gar nicht oder zu wenig in Betracht kommen.

Schließlich kommt dazu noch ein anderes. Die Familie der Scombriden ist bisher morphologisch und anatomisch nur höchst ungenügend bekannt gewesen, und deshalb haben auch den Versuchen einer phylogenetisch begründeten systematischen Anordnung ihrer Glieder die erforderlichen Grundlagen gefehlt.

Zum Teil ist die außerordentliche Größe ihrer Glieder einem eingehenden Studium hinderlich gewesen. So existieren z. B. in den zoologischen Museen von den größeren Thunfischarten nur wenige gute die normalen Verhältnisse wiederspiegelnde Skelette, und die Reihe der Abbildungen von solchen hat erst in allerjüngster Zeit eine befriedigende Vervollständigung erfahren.

Wesentlich ist aber auch, daß die Scombriden-, und in Sonderheit die Thynniden-Larven, bei weit übereinstimmenden Lebensgewohnheiten, sehr gleichartige morphologische Verhältnisse aufweisen, sodaß weder die Wirbelzahl noch die Anordnung und Zahl der Flossenstrahlen befriedigende Unterscheidungsmerkmale abgeben, während die allenfalls zu verwertende Form der Wirbel bei den Larven noch nicht genügend entwickelt ist.

Was die Literatur über den Gegenstand anbetrifft, so ist unter Hinweis auf das dieser Arbeit angehängte Schriftenverzeichnis zu sagen, daß von den älteren Werken besonders die Bearbeitung von Valenciennes viel wertvolle Angaben über anatomische Verhältnisse der Familie enthält, die von späteren Autoren meist übernommen sind. Einige Ergänzung haben diese Daten in den Arbeiten von Chr. Lütken, A. T. Masterman und E. Ch. Starks erfahren. Aber eine erschöpfende Darstellung mit zahllosen Details und durch viele vortreffliche Abbildungen illustriert findet sich erst in der 1923 erschienenen großen Monographie von K. Kishinouye, welche für uns den einzigen Nachteil hat, daß sie sich im wesentlichen auf die japanischen Formen beschränkt. Indessen ist die Zahl derselben so ansehnlich, auch zeigen die Arten zu denjenigen anderer Meere so viele Beziehungen, soweit sie nicht mit ihnen identisch sind, daß diese Beschränkung nicht allzusehr ins Gewicht fällt. Die Vielseitigkeit und die offenbar große Sorgfalt der Beobachtungen des japanischen Autors legen es uns nahe, der von ihm gegebenen Anordnung der Gattungen hier im Wesentlichen zu folgen. Wenn dieselbe in Zukunft wieder Veränderungen erfahren sollte, so könnte dies nur auf Grund einer genauen Kenntnis der Entwicklungsformen der Fall sein, zumal diese dem japanischen Autor fast völlig unbekannt geblieben sind.

Einstweilen ist die auch durch die gegenwärtigen Untersuchungen gewonnene Einsicht in die larvale Entwicklung der Scombriden nicht umfassend und zuverlässig genug, als daß sie eine wesentliche Aenderung der von Kishinouye vorgeschlagenen systematischen Anordnung rechtfertigen könnte.

Die Gattung Scomber ist von den übrigen Gattungen der Familie Scombridae (im weiteren Sinne) stärker verschieden als diese Gattungen von einander, und es ist daher wiederholt (Starks, Kishinouye), die Ansicht ausgesprochen worden, daß die Abtrennung dieser Gattung den Rest der Familie sehr viel homogener erscheinen lassen würde.

Zunächst haben die in Betracht kommenden Scomberarten alle die gleiche und von den Thynniden sehr weit abweichende Wirbelzahl, sodann entbehren sie des charakteristischen Dornbesatzes am Praeoperculum, der allen anderen Scombriden — freilich auch vielen Angehörigen anderer Familien z. B. der Carangiden — eigentümlich ist. Es kommt hinzu, daß die Scomber-Larven eine sehr viel gestrecktere Form

und einen kleineren und niedrigeren Kopf besitzen als die durchweg sehr gedrungenen Larven der Thynniden, und daß die 1. D. bei ihnen später entwickelt wird als die übrigen unpaaren Flossen.

Neben den Scombriden im engeren Sinne und mit diesen aus dem gleichen Stamme entspringend erscheinen bei KISHINOUYE die Cybiidae, englisch seerfishes, mit Cybium (= Scomberomorus Lacép) und Acanthocybium, sowie die Pelamiden mit Sarda (= Pelamis C. V.) und Gymnosarda, und diesen werden alle übrigen als Plecostei gegenübergestellt.

Diese Gruppierung gründet sich auf die Ausbildung eines sehr komplizierten subkutanen Cirkulationssystems und einer intensiven Durchblutung der Leber bei den Plecostei, welche seitens früherer Beobachter selten die richtige Beachtung gefunden haben, obgleich gerade hierin das wichtigste Moment der hohen Spezialisierung in der Entwicklung dieser Fische zu erblicken ist und die Grundbedingung für die große Gewandheit und Schnelligkeit ihrer Bewegungen, die ungewöhnlich hohe Temperatur ihres Blutes u. a. m.

Von den Plecostei zweigt KISHINOUYE zunächst die Thunnidae ab, als deren wichtigste Repräsentanten die Angehörigen der Gattung Thunnus erscheinen, für die ich hier nach dem Vorgange von LÜTKEN, GILL und F. A. SMITT, den Namen Orcynus beibehalte, und welcher die beiden wirtschaftlich wichtigsten Thunfischarten der »rote« (O. thynnus L.) und der »weiße« Thun (O. germo Lacép.) angehören.

Von den Thunnidae leitet KISHINOUYE endlich die Familie Katsuwonidae ab, benannt nach ihrem Hauptvertreter, dem Bonito, der im Japanischen den Namen »Katsuwo« führt. Ich nenne sie mit dem älteren Namen Euthynnidae und rechne zu diesen wie KISHINOUYE — die Gattungen Euthynnus mit Bonito (E. pelamis) und Thonine (E. alliteratus) und endlich die Gattung Auxis. Die letztere steht somit im System nicht — wie bei vielen älteren Autoren — neben Scomber, mit dem sie nur den großen Abstand der beiden Rückenflossen gemein hat, sondern neben der Thonine, mit der sie außer der gleichen Zahl der Rumpfwirbel und der Schwanzwirbel auch eine Reihe von weiteren Charakteren verbindet.

Wie schon LÜTKEN 1880, so bin auch ich heute an einem sehr viel größeren Material von Scombriden- speziell Thynniden-Larven nicht in der Lage zu sagen, auf welche Merkmale bei der Unterscheidung der Arten das Hauptgewicht gelegt werden soll. Der Form und Zahl der Wirbel muß natürlich sehr große Bedeutung beigemessen werden, aber die Geringfügigkeit der Unterschiede bei den einzelnen Arten erschwert die Bestimmung oft sehr, und es gelingt nicht immer, die Wirbel durch Färbung so klar sichtbar zu machen, daß sie fehlerfrei gezählt werden können.

Auch sonst zeigen die Thynniden Larven mancherlei übereinstimmende Züge in ihrer Entwicklung, und es ist leichter, diese hervorzuheben als die Verschiedenheiten aufzuweisen, an denen es natürlich auch nicht fehlt. Die Entwicklung der unpaaren Flossen geht in der Regel in der Weise vor sich, daß zunächst die heterocerke Schwanzflosse angelegt wird und dann ziemlich gleichmäßig alle übrigen unpaaren Flossen, wobei die 1. D. eher etwas voraus ist als im Verzuge. Die Insertionsstelle des ersten Stützstrahls der 1. D. liegt in der Regel zwischen den Spinalfortsätzen des 2. und 3. Wirbels. Selbst das bei der Mehrzahl der Arten entwickelte Pigment der 1. D. ist meist schon frühzeitig sichtbar. In diesem Verhalten der 1. D. liegt ein höchst beachtlicher Unterschied von den Scomberarten, bei denen, wie erwähnt, diese Flosse auffallend spät entwickelt wird. Von den paarigen Flossen sind die Brustflossen meist so groß, daß sie anfänglich den größten Teil des Eingeweidesacks bedecken und bis zur Senkrechten des Afters oder selbst darüber hinaus nach hinten reichen; und dasselbe gilt in fast dem gleichen Maße von den Bauchflossen, die in den meisten Fällen — der Bonito scheint eine Ausnahme zu bilden — ziemlich früh erscheinen.

Die auffällige Größe der paarigen Flossen ist indessen wesentlich abhängig von dem Umfang des Eingeweidesackes, der in den früheren Entwicklungsstadien im Profil die Form eines gleichschenkligen Dreiecks hat mit der Schwimmblase auf der Spitze und außerordentlich komprimiert ist, so daß die Dornen des Praeoperculum mehr oder weniger weit auf ihn heraufragen. Sobald der Eingeweidesack sich streckt und damit der After weiter nach hinten verlegt wird, erscheinen die paarigen Flossen verhältnismäßig kürzer und bedecken dann oft nur einen kleinen Teil des Eingeweidesackes. Diese Verlegung des Afters im Laufe der Entwicklung hat automatisch zur Folge, daß sich der sogen. postanale Raum, — d. i. der Ab-

stand des Afters von der Insertion der Afterflosse — im Laufe der Entwicklung entsprechend verkleinert. Allerdings behält derselbe trotzdem noch eine gewisse Größe, die je nach der Art verschieden und daher charakteristisch ist. Ein ziemlich gutes Unterscheidungsmerkmal gibt die Zahl und Beschaffenheit der Kieferzähne — und der meist auch vorhandenen Gaumenzähne ab, und dasselbe gilt in vermehrtem Maße von den Dornen am Rande des Praeoperculum, obwohl dieselben im allgemeinen nach einheitlichem Plan angeordnet sind und ihre taxonomische Verwertung auch deshalb Schwierigkeiten macht, weil ihre Zahl bis zu einem gewissen Zeitpunkt zunimmt, ihre Länge und Schärfe aber schon während der Larvenzeit wieder abnimmt.

Der allgemeine Plan, nach dem die Praeoperculardornen entwickelt sind, ist folgender: im Winkel des Praeoperculum stehen 3 größere Dornen, der größte von diesen in der Mitte; es folgen nach oben und nach vorn hin je eine Anzahl allmählich an Länge abnehmender, deren Zahl der Art nach wechselt und meist im Laufe der Entwicklung zunimmt.

Schließlich verdient noch die Verteilung des Körperpigments Erwähnung; sie ist, wenn vorhanden, fast immer charakteristisch; doch ist die Mehrzahl der hier beschrieben Formen in den frühen Entwicklungsstadien ganz oder fast ganz ohne Pigment auf dem Hinterkörper. Reichlich Pigment findet sich nur bei Scomber und Auxis.

GATTUNGEN.

SCOMBER.

Die Fänge von Makrelenlarven, welche »Thor« in den nordischen Gewässern gemacht hat, sind außerordentlich zahlreich und enthalten alle Entwicklungsstadien der nordeuropäischen Makrele von der eben ausgeschlüpften Larve bis zum Fischchen von 21,5 mm Länge. Ein tabellarisches Verzeichnis dieser Fänge, soweit sie aus den Jahren 1905 und 06 stammen, wurde von mir unlängst (1923, S. 17) veröffentlicht, und da auch alle Entwicklungsstadien des Fisches teils bei dieser teils bei früheren Gelegenheiten beschrieben und abgebildet wurden, so erübrigt sich an dieser Stelle ein näheres Eingehen auf diese Seite unseres Gegenstandes.

Nachdem wir nun aber über eine genaue Kenntnis der Entwicklungsformen der nordeuropäischen Makrele verfügen, wäre es von größtem Interesse gewesen, für die Makrele des Mittelmeeres eine Vergleichsreihe aufstellen und zugleich die Entwicklungsformen von Scomber colias kennen lernen und mit jenen vergleichen zu können. Die Hoffnung, das dafür erforderliche Material unter den Fängen des »Thor« zu finden, hat sich indessen nur in sehr bescheidenem Maße erfüllt.

Die Ursache hierfür ist wohl darin zu suchen, daß der »Thor« auf seinen Fahrten die Küstengewässer meist nur flüchtig berührte, und daß gerade in ihnen die Laichgebiet der Makrele — über Scomber colias wissen wir in dieser Beziehung fast nichts — zu suchen sein dürften, nochmehr vielleicht aber darin, daß die für das Laichen dieser Fische wichtigsten Monate, März, April, Juni für die Fahrten des »Thor« nicht oder fast nicht in Betracht kamen.

Im Ganzen handelt es sich nur um etwa 10 hierher gehörige Larven, und alle sind sehr jugendlich, von 6,7 bis 11 mm lang, sodaß über das Verhalten der älteren Formen nichts ausgesagt werden kann. Es ist aber bemerkenswert, daß diese wenigen Larven, die aus den verschiedensten Teilen des Mittelmeeres stammen, vom äußersten Westen bis zum äußersten Nordosten, sich auf 8 Fänge verteilen, von denen die eine Hälfte im Winter (Februar 09), die andere im Sommer (Juni bis August 1910) erbeutet wurde.

Dieser Sachverhalt machte es natürlich wahrscheinlich, daß die vorhandenen Scomber-Larven zwei verschiedenen Arten angehörten, und es lag nahe, den Versuch zu machen, sie den beiden aus dem Mittelmeer bekannten Spezies scombrus und colias zuzuweisen. Indessen ganz ohne einige Unstimmigkeiten gelingt dies doch nicht.

E. W. L. Holt (1899) hat zuerst planktonische Eier und dazu gehörige jugendliche Larven aus dem

Mittelmeer in Händen gehabt, deren Zugehörigkeit zu scombrus für wahrscheinlich gehalten werden durfte, und L. Fage (1910) hat die Vermutungen von Holt später bestätigt, wonach die Verteilung des Pigments beim Embryo und der Larve von Scomber scombrus aus dem Mittelmeer von demjenigen der nordischen Makrele etwas — und zwar nicht unerheblich — abweicht.

Indessen bezieht sich dies wesentlich nur auf das bei der Konservierung verschwindende gelbe Pigment dieser Larven und ist daher bei den ohnehin älteren Larven der »Thor«-Fänge nicht mehr zu verfolgen. Das bei diesen vorhandene Pigment zeigt im Allgemeinen dieselbe Anordnung wie bei den nordischen Makrelenlarven, wenn es auch durchweg matter ist. Namentlich stimmen die im Februar gefangenen Larven so gut mit den nordischen überein, daß man sie unbedenklich für Sc. scombrus erklären darf, während die aus dem Sommer stammenden Larven meist eine etwas abweichende Anordnung und Intensität des Pigments sowie auch sonstige Unterschiede erkennen lassen.

Fig. 1 a. Scomber scombrus. Von Woodshole (U.S.A.) 17. VI. 1906. 46 mm lang. Vergr. 2 × [1].

Die charakteristischen Züge der nordischen Makrelenlarve, die sich auch bei der Mittelmeerform wieder finden, sind folgende. Die kleinsten Larven, die noch einen Dotterrest besitzen und bei denen der Darm noch ohne Windung ist und der After im vordersten Körperdrittel liegt, sind etwa 3,5 bis 4 mm lang. Schon während der Dotterresorption legt sich der Darm in eine Windung, über der eine sich alsbald bis zum After nach hinten ausbreitende von kräftigem Pigment gedeckte Schwimmblase erscheint. Bei 5—6 mm Länge erscheint die hypurale Anlage der Schwanzflosse. Das längs der Körperkonturen vorhandene schwarze Pigment wird intensiver, wobei zunächst die Chromatophoren der ventralen Körperkontur wesentlich größer und kräftiger hervortreten als die der dorsalen; in den Kiefern erscheinen Zähne. Bei 7 bis 7,5 mm Länge ist das Urostyl leicht aufgebogen; bei 9 bis 10 mm ist die Schwanzflosse endständig; mit ihrer Entwicklung verstärkt sich das schwarze Pigment an der Basis ihrer Flossenstrahlen, namentlich in der oberen Hälfte der Schwanzflosse; von der Afterflosse und der 2. Rückenflosse sind die ersten Anlagen sichtbar. Bei 11 bis 12 mm werden in diesen beiden Flossen auch die Strahlen deutlich; das Körperpigment ist inzwischen intensiver geworden und namentlich auf der dorsalen Seite weiter nach vorn ausgebreitet. Bei 14 bis 16 mm beginnt der hintere Ausschnitt der Schwanzflosse sich zu bilden und zu vertiefen und zugleich erscheint, sehr verspätet, die erste Rükkenflosse, in zunächst sehr schwachen Andeutungen. Jetzt beginnt auch die bisher sehr geringe Zahl von 5 Zähnen jederseits oben und unten sich zu vermehren und nach und nach auf 13 anzuwachsen.

Fig. 1 b. Scomber scombrus. SO. von Cagliari (St. 42) 2. II. 1909. 7,4 mm lang. Vergr. 12,0 ×.

Die vielleicht bemerkenswerteste Veränderung, die im Laufe der hier skizzierten Entwicklung vor sich gegangen ist, besteht in der Ausdehnung des Eingeweidesacks und einer entsprechenden Verlegung des Afters nach hinten, sodaß letzterer der Insertion der Afterflosse wesentlich genähert ist, von der er ursprünglich sehr weit getrennt war. Das Ergebnis dieser Verschiebung ist, daß der After bei der Makrelenlarve zunächst im ersten und schließlich im letzten Drittel der Körperlänge ausmündet.

Wie bei den nordischen Makrelenlarven, so wird ein derartiger Sachverhalt auch bei einigen der im Mittelmeer erbeuteten Scomberlarven angetroffen, und diese sind daher — aus diesem und anderen Gründen — unbedenklich als Scomber scombrus anzusprechen. (vgl. fig. 1b).

[1] Die Vorlagen zu den Abbildungen sind grösstenteils von Frl. E. Mohr, zum kleineren Teil von Herrn Dr. W. Schnakenbeck gezeichnet.

Dagegen zeigt eine Reihe anderer Scomberlarven des Mittelmeeres — und zwar meist im Sommer geborener — ein anderes Verhalten. Bei diesen rückt der After der Larve viel früher nach hinten und hat schon bei den kleinsten Exemplaren von 7 mm Länge die Körpermitte erreicht, während dies bei Sc. scombrus erst bei etwa 15 mm Länge der Fall ist. Der Abstand des Afters von der Insertion der Afterflosse ist von vorn herein klein und viel geringer als bei Sc. scombrus; er beträgt nur etwa 4 bis 5 Myomerenbreiten gegen 7 bis 9 bei Sc. scombrus-Larven. (vgl. fig. 2a).

Ein weiteres Kennzeichen dieser Larvengruppe ist die ungemein schwache Ausbildung des Körperpigments, die wohl zum großen Teil darauf zurückzuführen ist, daß es sich um farbige Chromatophoren handelt, die bei der Konservierung stark verblassen. Freilich darf in diesem Merkmal allein keine spezifische Eigentümlichkeit erblickt werden; denn man findet nicht selten unzweifelhafte Scomber scombrus Larven — aus den nordischen Meeren — welche ähnlich schwach pigmentiert sind, und bei den Scomber scombrus Larven aus dem Mittelmeer scheint dies, wie schon hervorgehoben, sogar sehr oft der Fall zu sein. Aber bei den hier besprochenen Mittelmeerlarven sind ganz regelmäßig nicht nur im Peritoneum und über der Schwimmblase sondern auch im postanalen Körperabschnitt die nach dem Schema der Scomber-Pigmentierung angelegten Chromatophoren nur sehr schwach entwickelt und vermindern sich im Laufe der Entwicklung sogar noch. An der Basis der Analflosse finden sich nur 18 bis 10 Chromatophoren — später auf 5 bis 6 vermindert, — an der dorsalen Körperkante nur 6—7 und 2—3. An der Basis der Schwanzflossenstrahlen fehlen sie ganz oder sind nur äußerst schwach entwickelt. Zähne sind zunächst 4—6 später 8—10 jederseits oben und unten vorhanden.

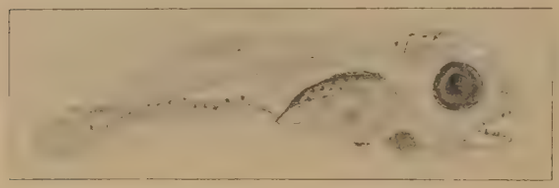

Fig. 2a. Scomber colias(?) Cap Carbonara, Sizilien (St. 40) 1. II. 1909. 9,1 mm lang. Vergr. 8,0 ×.

Die stark gewölbte Schnauze ist auffallend kurz und meist erheblich kürzer als der Durchmesser des sehr großen Auges (größer als bei Sc. scombrus).

Das größte Exemplar dieser Gruppe von Scomber-Larven ist nur 11 mm lang, läßt aber bereits die Anlage einer ersten Rückenflosse und in dieser einige sehr kleine Strahlen — wenn auch nicht in definitiver Zahl — erkennen. (vgl. fig. 2b). Es ist also mit der Möglichkeit zu rechnen, daß diese Scomberart die erste Rückenflosse früher anlegt als Sc. scombrus der nordischen Meere; dabei bleibt allerdings wegen mangelnden Materials vorläufig noch ungewiß, ob Sc. scombrus im Mittelmeere in dieser Beziehung sich ebenso verhält wie in den nordischen Gewässern.

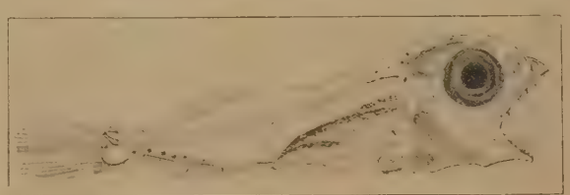

Fig. 2b. Scomber colias (?) Dardanellen (St. 178) 12. VIII. 1910. 11,0 mm lang. Vergr. 7,0 ×.

Die hervorgehobenen Unterschiede der zweiten Gruppe von Scomber-Larven erscheinen groß genug, um die Zuweisung zu einer anderen Art zu rechtfertigen und als solche kommt natürlich Sc. colias, in England Spanische Makrele genannt, in Betracht, wenn man Steindachner folgend annimmt, daß die einzige sonst noch aus diesen Gewässern beschriebene Form, Sc. pneumatophorus de la R. als Jugendform von Sc. colias anzusehen ist. Zur größeren Sicherstellung dieser Bestimmung wird es jedoch notwendig sein, etwa noch bekannte Daten aus der Morphologie und Biologie der Scomber-Arten des Mittelmeeres zur Kontrolle heranzuziehen. Leider sind diese Daten recht spärlich, und es findet sich mehr Übereinstimmendes als Verschiedenheiten zwischen beiden Arten.

Bezüglich des Übereinstimmenden ist darauf zu verweisen, daß die Zahl der Flossenstrahlen mit Ausnahme der 1. Dorsale bei beiden Formen fast genau die gleiche ist. Die Zahlen der 1. Dorsale können aber zur Unterscheidung der Larven nicht benutzt werden, da diese Flosse, wie erwähnt, erst sehr spät angelegt wird, und darüber hinaus die Zahl ihrer Flossenstrahlen noch lange unentschieden bleibt. Noch weniger brauchbar ist die Wirbelzahl, da sie bei beiden Formen vollkommen übereinstimmt und mit einer

äußerst geringen Variabilität fast ausnahmslos zu 14 + 17 = 31 gefunden wird. (vgl. fig. 1a). Auch die Schwimmblase bietet kein brauchbares Unterscheidungsmittel; sie soll zwar in den erwachsenen Formen nur bei colias anzutreffen sein, ist aber im Larvenstadium bei beiden anscheinend ganz gleichmäßig entwickelt.

Über die Laichzeit der Makrele des Mittelmeeres existieren nur wenige zuverlässige Angaben, welche keineswegs gut miteinander übereinstimmen. Letzteres ist aber vielleicht darauf zurückzuführen, daß das Laichen in verschiedenen Teilen des Mittelmeeres zu verschiedenen Zeiten erfolgt, obwohl wir von der nordeuropäischen Makrele wissen, daß sie auf sehr ausgedehntem Gebiet ziemlich genau gleichzeitig laicht. Nach Marion fällt die Laichzeit von Sc. scombrus im Golfe du Lion hauptsächlich in die Monate März, April und erste Hälfte Mai. L. Fage gibt für dasselbe Gebiet an, daß die planktonischen Eier der Makrele im April bis Juni angetroffen werden — also ähnlich wie oder wenig früher als in den nordeuropäischen Meeren. In den osmanischen Gewässern werden nach meinen eigenen Angaben Makrelen, die unmittelbar nach dem Laichen stehen (»tschiros«), im April und Mai gefangen, und man glaubt, daß das Laichen im Marmor Meer im Februar und März stattfindet. Die russischen Angaben über das Laichen im Schwarzen Meer sind wahrscheinlich unrichtig, da dieses Meer allem Anschein nach als Laichgebiet überhaupt nicht in Betracht kommt. Dagegen verdienen die Angaben der österreichischen und ungarischen Autoren Krisch und v. Gauss-Garady Erwähnung, wonach das Laichen in der Adria schon im Dezember beginnen und übrigens in die Monate Januar und Februar fallen soll, während im März nur noch ausgelaichte Exemplare angetroffen werden.

Sehr viel unzulänglicher sind die Nachrichten über das Laichen von Sc. colias. Speziell über das Verhalten der Art im Mittelmeer fehlt es ganz an Daten. Nun wird aber Sc. colias als kosmopolitisch und die im Pazifik, wie im Atlantik und im Mittelmeer vorkommenden Formen als zur gleichen Art gehörig angesehen. Daher wäre es möglich, daß die von japanischen Autoren gemachten Beobachtungen auch für die Mittelmeerform Geltung hätten, nämlich, daß bei einer Eizahl von 3—400 000 die Eier 1 mm im Durchmesser groß seien, keine(!) Ölkugel besäßen, sich bei 13 bis 14° C in einer Woche entwickelten, und daß die Laichzeit in die Monate April bis Juli falle; Kishinouye sagt: »Mackerel spawn in May«. Allerdings verdient Beachtung, daß die amerikanischen Autoren B. W. Evermann und W. C. Kendall die spezifische Verschiedenheit von Sc. colias Gmelin und Sc. japonicus Huttuyn — wie mir scheint mit Erfolg — glauben nachweisen zu können. Die atlantische Form soll einen kürzeren Kopf, geringeren Abstand der 1. Dorsale von der Schnauzenspitze und größeren Abstand der Insertion der 1. Dorsale von derjenigen der 2. Dorsale haben.

Immerhin kann es nach diesen Daten als nicht unwahrscheinlich angesehen werden, daß Sc. colias im Mittelmeer später laicht als Sc. scombrus, und daß sich seine Laichzeit in einigen Teilen dieses Meeres bis in den August hineinzieht.

Damit würde dann stimmen, daß die von mir zu Sc. colias gestellten Larven mit einer einzigen Ausnahme alle aus einer wesentlich späteren Jahreszeit stammen als die Sc. scombrus-Larven. Letztere wurden bei Cadiz, bei Tanger und südlich Sardinien und alle im Februar gefangen, erstere bei Oran, Elba und den Dardanellen im Juni, Juli und August und nur in einem 9 mm langen Exemplar am 1. Februar bei Sardinien.

Es ist unverkennbar, daß dieses letztere Datum nicht stimmt zu dem Bilde, welches sich durch die übrigen Tatsachen gewinnen läßt. Aber es liegt kein Anlaß vor, hier einen Irrtum anzunehmen.

Vielleicht ist die Erklärung darin zu suchen, daß sich doch die Laichzeit beider Arten sehr lange hinzieht, wenn das ganze Gebiet des Mittelmeeres berücksichtigt wird, daß unter dieser Voraussetzung die Laichzeiten beider größtenteils zusammenfallen, und daß die Hochzeit des Laichens für beide in eine Jahreszeit fällt, die für die Fahrten des »Thor« im Mittelmeer nicht in Betracht kam.

Schließlich sei doch nochmals betont, daß die Zugehörigkeit der hier beschriebenen Larven zur Gattung Scomber wohl keinem Zweifel unterliegt, daß aber das Vorhandensein von Sc. colias als unsicher bezeichnet werden muß, da eine verläßliche Zurückführung der entsprechenden Larven auf diese Stammform nicht möglich war.

Folgendes ist eine Übersicht der Scomber-Larven, welche vom »Thor« im Mittelmeer gefangen wurden.

Verzeichnis der beobachteten Scomber-Larven.

J. Nr.	Zeit	Ungefähre Ortsangabe	Länge der Leine	Zahl der Larven	Größen in mm	Zugehörigkeit
40	$^{1}/_{2}$ 09	Cap Carbonara auf Sardinien	65 m	1	9,1	colias fig. 2 a
42	$^{2}/_{2}$ 09	SO von Cagliari	300 -	2	7,1; 7,6	scombrus fig. 1 a
62	$^{22}/_{2}$ 09	W. von Tanger	25 -	2	6,9; 9,5	»
65	$^{24}/_{2}$ 09	Golf von Cadiz	600 -	1	6,4	?
108	$^{25}/_{6}$ 10	NO von Oran	65 -	1	6,7	colias
126	$^{10}/_{7}$ 10	W. Insel Elba	25 -	2	6,9; 7,4	»
178	$^{12}/_{8}$ 10	Dardanellen	65 -	2	7,5; 11,0	» fig. 2 b

PELAMIS SARDA C. V.

Diese Form, die in verschiedenen Teilen des Mittelmeeres, namentlich im Osten, fischereilich von großer Bedeutung ist, kommt auch in anderen Meeren vor, namentlich im Atlantik, wo sie vom Kap der Guten Hoffnung bis zur Nordsee und bis Massachusetts verbreitet ist und gelegentlich (an der amerikanischen Küste) in großen Mengen erbeutet wird. Es ist aber zweifelhaft, ob es sich in beiden Meeren um dieselbe Art handelt, wie denn die aus dem Westpazifik angegebene japanische Form Sarda orientalis = P. orientalis Schleg. bestimmt verschieden ist von der atlantischen, und sogar auch von einer anderen, die an den pazifischen Küsten von Nord- und Südamerika verbreitet ist (Sarda chilensis C. V.).

Für die japanische Art gibt Kishinouye Vert. = 25 + 20 an; H. M. Kyle zählte auf meine Bitte an einem Exemplar des South Kensington Museums: 23 + 23 = 46.

Für die atlantische Form gehen die Angaben über die Wirbelzahl so auffallend auseinander, daß man zu der Annahme gedrängt wird, es müßten auch hier verschiedene Formen beobachtet sein; oder man muß die Differenzen darauf zurückführen, daß einige Autoren (Günther) die stark verwachsenen 3 letzten Wirbel nur als einen gezählt haben. Cuvier und Valenciennes geben an — und nach ihnen vermutlich auch Günther — Vert. 25 + 25 = 50. »Le premier interosseux de l'anale s'attache au-devant de l'apophyse épineuse le la 26^{e} vertèbre«. H. M. Kyle zählte für mich an einem Exemplar in South Kensington: 23 + 30 = 53. Fr. Rosenthal, der ein Skelett ohne Angabe der Herkunft abbildet, gibt an 27 + 27 = 54.

Auch ich selbst habe an 2 Exemplaren von 26 und 42 cm Länge, welche von dem Fischmarkt zu Konstantinopel stammten, eine Gesamtzahl von 53 bis 54 Wirbeln feststellen können, wobei es ziemlich schwierig war, die Trennung zwischen Bauchwirbeln und Schwanzwirbeln mit genügender Sicherheit vorzunehmen; bei dem größeren Exemplar wurden 26 + 27, bei dem kleineren und deutlicheren aber 28 + 26 Wirbel gezählt, und es ist nicht ohne Interesse, somit festzustellen, daß in der Wirbelzahl dieser Art eine wesentlich größere Variabilität zu herrschen scheint als bei den verwandten Formen der Familie.

Charakteristisch ist die Stellung der 2. Rückenflosse, welche einerseits vollkommen an die erste herangerückt ist, andererseits fast vollständig vor der Insertion der Afterflosse steht; auffällig ist der große Unterschied in der Zahl der dorsalen und der analen Flößchen; die von Günther gegebene Formel lautet: D: 22 + 2/13 bis 14 + VIII—IX A: 2/13 + VII.

Unter dem von mir untersuchten Larvenmaterial aus dem Mittelmeer fand sich ein vereinzeltes Exemplar, welches mit einiger Wahrscheinlichkeit hierher zu stellen ist. Es ist eine 7,2 mm lange Larve von der Station 108 des »Thor«, d. i. von der afrikanischen Küste nordöstlich von Oran, woselbst sie am 26. Juni 1910 mit dem Yngeltrawl bei 2000 m Leine gefangen wurde.

Der noch jugendliche Charakter der Larve erhellt aus der geringen Ausbildung und der embryonalen Form der Schwanzplatte, in der die Flossenanlage unter dem ganz gerade nach hinten verlaufenden Urostyl nur eben angedeutet ist. Von den übrigen unpaaren Flößchen ist die sehr weit hinter dem After ansetzende Analflosse ebenso wie die 2. Rückenflosse in ihren Trägerteilen mit je etwa 13 Elementen erkennbar, die 1. Rückenflosse jedoch kaum angedeutet. Die Brustflossen sind groß und reichen über den After hinaus nach hinten; die Bauchflossen sind verhältnismäßig schon weit entwickelt. Der After liegt erheblich vor der

Körpermitte (Verhältnis etwa 4 : 5), sodaß die Larve wesentlich gestreckter erscheint als die meisten anderen Thynniden. Die Wirbelzahl läßt sich mit Sicherheit noch nicht feststellen, doch läßt die Zahl der Myomeren auf etwa 28 + 25 Wirbel schließen, und hierin lag der stärkste Hinweis auf die Möglichkeit der sonst nicht zu begründenden Annahme, daß die vorliegende Larve als Pelamis sarda C. V. anzusprechen sei.

Wie aus der Abbildung (Fig. 3a) ersichtlich, ist die Larve durch eine eigentümliche Ausbildung und Verteilung des Pigments charakterisiert.

Zwei große stark kontrahierte Pigmentpunkte und vielleicht ein kleinerer finden sich an der Basis der A-Flosse, je ein sehr kleiner oberhalb und unterhalb der Spitze des Urostyls. Auch an der Spitze der Bauchflossen und der Kiefer ist Pigment bemerkbar; größere und dichtere Ansammlungen finden sich im Peritoneum und in der Stirngegend.

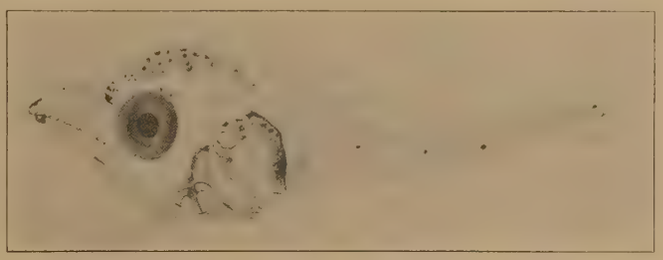

Fig. 3a. Pelamis sarda C. V. (?). NO. von Oran (St. 108) 26. VI. 1910 7,2 mm lang. Vergr. 12,0 ×.

Das Praeoperculum zeigt die in der Skizze (Fig. 3b) wiedergegebene charakteristische Bewaffnung mit Dornen; die vordere Leiste trägt 3 ziemlich große Spitzen, eine am vertikalen, und 2 am horizontalen Ast. Der Hinterrand des Praeoperculum trägt 6 Dornen; von diesen sind die 2 mittleren am Winkel stehenden sehr lang (der obere ist der längere) und reichen weit auf den Eingeweidesack hinauf; nach oben und unten von diesen zwei längsten Dornen folgen dann noch je ein mittelgroßer und ein sehr kleiner. Mit Ausnahme der beiden letzten sind alle Dornen sehr schlank, schmal und leicht brüchig. Auch am Hinterrande der Otocyste steht ein kleiner spitzer nach hinten gerichteter Dorn.

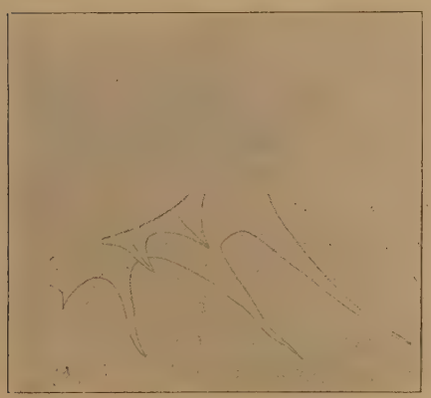

Fig. 3b. Pelamis sarda C. V. (?). NO. von Oran (St. 108) 26. VI. 1910. 7,2 mm lang. Präoperculum. Vergr. 50 ×.

Die Kiefer tragen etwa je 10 spitzige Zähnchen jederseits oben und unten; auch ein minimaler Gaumenzahn ist jederseits schon erkennbar. Der Oberkiefer greift etwas über den Unterkiefer hinweg.

Es braucht nicht verhehlt zu werden, daß die Zuweisung dieser Larve zu Pelamis sarda auf recht schwachen Füßen steht, und daß die Beibringung weiterer Entwicklungsstadien vielleicht zu einer Revision dieser Bestimmung führen wird. Zunächst aber darf gesagt werden, daß als Stammform etwa noch die Gattung Cybium = Scomberomorus in Betracht kommen könnte. Diese ist aber im Mittelmeer äußerst spärlich und eigentlich nur mit der abweichenden Form Acanthocybium solandri Jord. vertreten, welche selten ist und eine erheblich größere Wirbelzahl (66) besitzt.

Über die Entwicklungsgeschichte des Pelamiden ist nur wenig bekannt; ich verweise hierfür auf meine Ausführungen im »Fischerboten« 1917 S. 192. Dieselben betreffen das Vorkommen dieses Fisches in den osmanischen Gewässern, woselbst er fischereilich eine ungemein wichtige Rolle spielt. Dem Italiener L. Sanzo ist es vor Jahren in einer sizilianischen Tonnara gelungen, die Eier des Pelamiden von einem reifen Weibchen zu gewinnen und danach die gleichartigen planktonisch vorkommenden Eier zu identifizieren. Er fand den Durchmesser zu 1,21 bis 1,27 mm und die Größe der Ölkugel zu 0,31—0,35 mm. Die Eier sind also ziemlich viel größer als diejenigen des Thuns; ihr Dotter ist segmentiert. Nach kaum zwei Tagen entschlüpft ihnen eine wenig entwickelte Larve mit farblosen Augen, ziemlich weit hinter dem Dottersack ausmündendem After und mit spärlichem gelben und schwarzen Pigment, welches namentlich in der Umhüllung der Ölkugel hervortritt, die in der Mitte des Dottersackes belegen ist. (vgl. die sehr unzulänglichen Abbildungen a. a. O.).

Über die Lage der Laichzeit macht Sanzo keine Angaben; es scheint aber, dass dieselbe annähernd mit derjenigen des Thuns zusammenfällt.

GATTUNG ORCYNOPSIS.

Unter dem Namen Gymnosarda nuda (Gthr.) beschreibt KISHINOUYE einen japanischen Scombriden, den er mit RÜPPEL's Thynnus (Pelamis) unicolor und KLUNZINGER's Pelamis nuda Gthr. identifiziert und verwandschaftlich unmittelbar neben den Pelamiden (Pelamis sarda C. V.) stellt. Dieser Form nahestehend, aber sehr wahrscheinlich nicht mit ihr identisch ist Orcynopsis unicolor Geoffr., der zuerst von Ägypten beschrieben wurde. Auch ich erhielt ein Exemplar dieser letzteren Art von 36 cm Länge, welches JOHS. SCHMIDT auf dem Markt von Alexandria erworben hatte. Dasselbe hatte folgende Flossenformel, D: 13 + 13 + VIII A: 14 + VII P: 1 + 23 V: 1 + 5 Vert: 17 + 20 = 37, während KISHINOUYE angibt D: 14 + 13 + VII A: 12 + VI Vert: 19 + 19 = 38. Im Mittelmeer ist Orcynopsis unicolor Geoffr. nach übereinstimmenden Angaben der Literatur sehr selten, und es fand sich auch keinerlei Hinweis dafür; dass diese Art unter unserem Larvenmaterial vertreten sei. Dagegen scheint sie an der Mauritanischen Küste von Westafrika sehr häufig zu sein und ein wichtiges Fischereiobjekt zu bilden.

GRUVEL bemerkt von ihr, dass sie unter dem Namen Tasarte bekannt und bei den Kanarischen Inseln sowohl als längs der Festlandküste von Cap Juby bis Cap Blanco regelmässig und in sehr großen Mengen, namentlich in den Monaten April bis Juli, angetroffen werde. Hier werden vermutlich auch die Larven zu finden sein.

GATTUNG ORCYNUS.

Die Gatting Orcynus ist in den Fängen des »Thor« zweifelsohne mit einer größeren Zahl von Exemplaren vertreten, aber es ist nicht ganz leicht festzustellen, welcher von ihren beiden Arten die Fischchen angehören.

Die beiden in Betracht kommenden Arten sind:

Orcynus thynnus L., der große oder rote Thun,

und „ germo Lacép, der weiße Thun oder Germon.

Zweifelsohne spielt der erstere im Mittelmeer eine größere Rolle als sein kleiner Verwandter, und die Küsten des Mittelmeeres und der Eingang in dieses Meer vom Atlantik her sind wohl diejenigen Gebiete, in denen der große Thun in beträchtlicheren Mengen gefangen wird als irgend wo anders; indessen ist auch der Germon in vielen Teilen des Mittelmeeres nicht selten, wenn er auch im offenen Atlantik sicherlich in größerer Zahl vorkommt.

Unter Hinweis auf die am Ende dieser Arbeit aufgeführte Literatur sei zur Charakteristik der beiden Arten hier kurz folgendes gesagt.

Über die Laichverhältnisse und Entwicklungsformen des GERMON ist ganz außerordentlich wenig zuverlässiges bekannt. Man weiß, daß dieser Fisch regelmäßig zu Beginn des Sommers — anscheinend von Süden oder Südwesten kommend — in der Biskaya erscheint und dort Gegenstand einer sehr bedeutenden Angelfischerei ist, die haupsächlich von französischer Seite mit zunehmender Beteiligung betrieben wird. Letzteres ist der Grund, weshalb die französische Abteilung der Internationalen Meeresforschung sich dem Studium dieses Fisches mit besonderem Interesse und Eifer zugewandt hat. Die bisher gewonnenen Ergebnisse beschränken sich auf die Feststellung, daß in der Biskaya der Thun — oder vielleicht richtiger seine Nährtiere — sich als stenotherm und stenohalin erweist, insofern sein Auftreten an sehr eng umgrenzte Temperatur- und Salzgehaltverhältnisse gebunden erscheint. Außerdem weiß man, daß die Wanderung des Germon in die Biscaya, nur der Nahrungsaufnahme gilt, und daß die Fische zur gegebenen Zeit sehr freßbegierig sind, da sie unmittelbar nach dem Laichen stehen und stets leer angetroffen werden. Jedenfalls hat die Wanderung in die Biskaya mit dem Laichgeschäft nichts zu tun, und man kann als feststehend nur angeben, daß die Laichzeit vor den Beginn dieser Wanderung, also annähernd in dieselbe Zeit fallen muß wie beim großen Thun.

Wenn es nach dem Gesagten wahrscheinlich ist, daß die Laichgebiete des Germon im Atlantik irgendwo südlich oder westlich der Biskaya liegen, so kann doch nicht behauptet werden, daß dieser Fisch ausschließlich hier laicht. Im Gegenteil ist als sicher anzunehmen, daß das z. B. auch im Mittelmeer

geschieht, denn wie bei anderen Angehörigen des Thunfisch-Geschlechts, so ist es L. Sanzo auch beim Germon gelungen, von laichreifen Exemplaren, welche in sizilianischen Tonnaren gefangen wurden, die Eier, wenn auch unbefruchtet, zu gewinnen. Dieselben erweisen sich etwas kleiner als diejenigen des großen Thuns, nämlich nur 0,96—0,98 mm im Durchmesser, mit einer Ölkugel von 0,23—0,26 mm im homogenen Dotter und mit zarter Netzzeichnung auf dem Chorion.

Weitere Mitteilungen finden sich bei Lütken in »Spolia Atlantica«, woselbst einige zweifellos thunartige Fischchen von 8 bis 17 mm Länge beschrieben und abgebildet sind (l. c. pag. 482), welche meist im Atlantik, vereinzelt auch im Südchinesischen Meer, erbeutet wurden. Diese Larven ähneln unseren im Folgenden zu beschreibenden Larven sehr vollkommen; indessen ist es nicht festzustellen, weshalb Lütken sie als wahrscheinlich zum Germon und nicht zum großen Thun gehörig betrachtet hat.

Etwas besser als über den Germon sind wir über die Biologie des grossen Thuns unterrichtet.

Der große Thun stand — hauptsächlich auf Grund der eigentümlichen Erscheinungen in der Periodizität, in der er sich dem Fange darbietet — langezeit in dem Rufe, sich im Mittelmeer, das er angeblich durch die Straße von Gibraltar im Frühjahr betrete, nur vorübergehend aufzuhalten. Er solle es in einer bestimmten Wanderrichtung — dem Sinne der Bewegung des Uhrzeigers entgegengesetzt — längs der Nordküste Afrikas beginnend umkreisen, dabei im Schwarzen und Asowschen Meere seine Laichprodukte absetzen (was bestimmt nicht zutrifft) und schließlich längs der europäischen Küste des Mittelmeeres in den Atlantik zurückkehren, sodaß er auf diser Wanderschaft das Land stets zur Rechten behalte.

Diese Theorie ist seit Aristoteles, Strabo und Plinius von vielen in Betracht kommenden späteren Autoren bis in die neueste Zeit vertreten worden und wird noch Ende des vorigen Jahrhunderts von dem sehr ernst zu nehmenden Marseiller Forscher P. Gourret verfochten, dem wir mit die besten Materialien über den Thunfischfang im Golfe du Lion und Daten über die Biologie des Thuns verdanken.

Indessen hat es auch schon frühzeitig Forscher gegeben, welche die beobachteten Tatsachen mit dieser Theorie nicht für vereinbar hielten, und als einer der ersten unter diesen verdient Valenciennes genannt zu werden. In neuerer Zeit haben besonders Pavesi und zuletzt L. Sanzo, auf Grund seiner Beobachtungen an der sizilianischen Küste, auch J. P. Bounhiol in Algier in mehr oder weniger originaler aber übereinstimmender Weise den Nachweis zu führen versucht, daß der Thun seinen Lebenskreislauf im Mittelmeer vollende, daß er sich im Frühjahr der Küste nähere, um dort zu laichen, einen Teil des Sommers dort verbleibe und erst im Herbst seine Winterquartiere in offener See und in mehr oder weniger tiefem Wasser aufsuche. Die von diesen Autoren vorgebrachten Beweisgründe sind so schwerwiegend, daß man sich ihnen, abgesehen von Einzelheiten, kaum verschließen kann.

Schon Valenciennes hält es für sicher, daß die Thunfische im Mittelmeer laichen, daß die Jungen dort massenhaft geboren werden und mit großer Geschwindigkeit heranwachsen. Nach dem Zeugnis des D'Amici, Herzogs von Ossada (Messina 1816), das offenkundig den Stempel unzulänglicher Beobachtung trägt, gibt er an, daß die Eier um die Mitte Juni auf Pflanzenwuchs abgestreift und ebendort von den Männchen befruchtet werden. Im Juli sei schon junge Brut bemerkbar (»nunzintuli«), die aber nur $1^1/_2$ Unzen wiege und im August auf fast 4, im Oktober auf 30 Unzen Gewicht heranwachse. Von den Gewässern Sardiniens weiß Valenciennes zu berichten, daß die Thunfische dort ebenso laichen wie bei Sizilien, daß man ihre Eier dort oft schon im Monat Mai findet, und daß die Fische auch dort von den Meereicheln (Posidonia caulinii) angezogen werden, mit denen die Ränder des Meeres bedeckt sind, zu denen sie jedoch in Wirklichkeit keinerlei Beziehungen haben.

Als einer der stärksten Beweise gegen die alte Wandertheorie muß die Tatsache angesehen werden, daß die Thunfische sich überall nahezu gleichzeitig zeigen; denn nach jener Theorie müßte man erwarten, daß sie erst an gewissen Küsten vorbei kommen, um danach an anderen zu erscheinen. Die nicht fortzuleugnende Tatsache, daß die Thunfische an jeder Küste einer ganz bestimmten Richtung bei ihrer Ankunft folgen und der entgegengesetzten bei ihrem Abzuge, und daß die Tonnaren als mehr oder weniger günstig aufgestellt angesehen werden müssen, je nachdem sie den Fisch früher oder später fangen können, wird man durch die Annahme viel weniger ausgedehnter Wanderungen erklären müssen.

P. Pavesi nimmt als ständigen Aufenthaltsort der Thunfische während der Zeit, in der sie sich dem Fange entziehen, die großen Tiefen des Meeres an, von 1000—1500 Faden Tiefe, und betrachtet als solche besonders diejenigen im Golf von Cadiz sowie im westlichen Mittelmeer, im Tyrrhenischen und im Jonischen Meere. Aus diesen großen Tiefen, steigen, so meint er, die Thunfische zu Beginn der Fangzeit im Frühjahr an die Küste auf, und zwar erst vertikal nach oben, dann horizontal in bestimmten Richtungen und längs der Küsten, in beschränkter Ausdehnung, wodurch das Bild der zuziehenden Fische (tonni di corsa oder poissons de course) entsteht, dem der später in gleicher Weise entstehende Schein der zurückwandernden Fische (tonni di ritorno oder poissons de retour) entspricht. Diese Annahme von Pavesi wird gestützt durch das Vorhandensein großer Meerestiefen in der Nähe solcher Orte, an denen Tonnaren für zuziehende und für abziehende Fische aufgestellt sind, was er an der Hand einer Übersichtskarte über die Stellung der Tonnaren zu den benachbarten Tiefen darzulegen sucht.

Von besonderem Interesse sind die zahlreichen Einwände, die Pavesi gegen die alte Wandertheorie geltend zu machen weiß. So gibt er eine Reihe von Daten über das Erscheinen und das Verweilen der zuwandernden Thunfische (tonni di corsa), welche durchaus nicht darauf hindeuten, daß die Fische vom Westen her kommen. In der Adria werden diese zuwandernden Thunfische Ende März und im April gefangen, dagegen an der portugiesischen Küste von Algarve erst im Mai und Juni. Andererseits beginnt der Fang an der spanischen Mittelmeerküste bei Cartagena und Alicante Mitte Januar oder Mitte Februar, dagegen bei Marseille und Toulon Anfang oder im letzten Drittel April. Bei Sizilien dauert nach d'Amici die Zuwanderung regelmäßig vom 8. Mai bis 8. Juni, und auch in Korfu, bei Smyrna sowie in den Dardanellen und im Bosporus werden die Thunfische in der ersten Hälfte des Mai gefangen.

Wenn alle Thunfische von Westen kämen, so müßte man im westlichen Teil des Mittelmeeres besonders günstige Fangverhältnisse erwarten. Das ist aber nicht der Fall, wie schon die geringe Zahl der dort vorhandenen Tonnaren anzeigt. Auch an der spanischen Küste, zwischen Mazaron und Valenzia, sowie an der afrikanischen von Oran bis Algier werden wenig Thun gefangen, und selbst an der französischen Küste werden noch nicht soviel erbeutet, als eine einzige erstklassige italienische Tonnare ergiebt. Dagegen geben die Tonnaren von Calabrien, Sardinien und den Ägadischen Inseln an der Westecke Siziliens sowie die von Sidi Daud in Tunis sehr reiche Fänge; letztere hat einen mittleren Jahresertrag von 10,000 Meterzentnern an zuwandernden Thunfisch und übertrifft damit alle Tonnaren des Gebietes von Sevilla. Die Tonnaren la Favignana und la Formica auf Sizilien fangen etwa je 8000 Stück Fische.

Im ganzen kann man rechnen daß im Jahre etwa 100,000 bis 150,000 Thunfische als sogenannte zuwandernde Fische gefangen werden. Beginnt dann der Fang der rückwandernden, so liegt dafür die Tonnare von Marzamemi, an der Südostecke von Sizilien, besonders günstig; sie fängt aber weniger als 3000, während die im Westen, südöstlich von Cadiz gelegenen la Barbata und la Zahara 8500 überschreiten und la Tuta an der Guadiana-Mündung sogar 16,000 erreicht, obwohl man nach der Theorie annehmen müßte, daß hier die Thunfische bereits stark dezimiert sind, wenn sie eintreffen. An der portugiesischen Küste ist der Ertrag der Tonnaren di ritorno ganz allgemein etwa doppelt so groß wie der der Tonnaren die corsa. Danach würden die Thunfische trotz der starken Eingriffe der Fischerei in größerer Zahl zurückkehren müssen, als sie auszogen; es müßten also wohl die großen Fische die kleinen inzwischen schnell heranwachsenden mit sich nehmen!

Pavesi weist ferner darauf hin, daß die Thunfische doch auch im Winter im Mittelmeer keineswegs fehlen. Daß sie an der französischen Küste zu dieser Zeit gefangen werden, wurde schon erwähnt; Giglioli hat sie im November und Dezember (1881) fast jeden Tag auf dem Markt von Messina gesehen, da man gelernt hatte, sie zur angegebenen Zeit mit der phalangresa (Langleine) zu fangen. Ebenso wie in Sizilien werden sie auch in Sardinien im Winter gefangen, und zwar in der Tiefe der Buchten statt am Strande, weshalb man diese Fische als »golfitani« bezeichnet. Daß diese golfitani von den zuwandernden und abwandernden Thunfischen nicht verschieden seien, war schon d'Amici's Überzeugung, da er zu beobachten glaubte, daß die gefangenen golfitani an Zahl zunehmen, nachdem die Regierung infolge seiner Vorstellung über die Gefährdung des Thunfischbestandes durch Verordnung vom Oktober 1801 den üblichen Fang an der Küste verboten hatte.

Auch für die Fortpflanzung des Thuns im Mittelmeer glaubt Pavesi sichere Anhaltspunkte geben zu können. Nachdem schon d'Amici kleine Exemplare von 40 g Gewicht in Händen gehabt hatte, gab Döderlein an, die Gewässer von Palermo bevölkerten sich nach dem Verschwinden der großen Thunfische mit sehr kleinen Exemplaren, deren Wachstum man genau verfolgen könne. Nach Giulio Drago (1850) hätten sich in den Kammern einer Tonnare bei Camogli (Genua) tausende von sehr kleinen Thunfischen vorgefunden, und Pavesi selbst weiß zu berichten, daß im Jahre 1880 in der Tonnara del Brusq bei Toulon 15 bis 16 000 junge Thunfische von Sardinengröße gefangen wurden.

Natürlich kann man mit Recht einwenden, daß diese Angaben von Pavesi über das Vorkommen junger Thunfische noch nichts über den Vollzug des Laichgeschäftes selbst beweisen, zumal die Schnelligkeit des Wachstums beim Thun noch nicht zuverlässig bekannt ist.

In dieser Beziehung ruhen in der Tat die Anschauungen von Pavesi über die Wanderungen der Thunfische auf keiner sichereren Grundlage als die der älteren Autoren. Wesentlich festeren Boden betreten wir erst an der Hand der von L. Sanzo in sizilianischen Tonnaren gemachten Beobachtungen, bei denen er nicht nur laichreife Fische feststellte, sondern auch von ihnen Eier gewann. Wir wissen dadurch, daß das Ei — ähnlich demjenigen der Makrele — nur 1,05 bis 1,12 mm im Durchmesser hat und eine große Ölkugel von 0,27 mm besitzt. Die Eihaut zeigte eine netzartige Zeichnung und die Mikropyle befand sich am Grunde einer trichterförmigen Vertiefung. Diese Eier wurden bei Palermo am 8. und 14. Juni beobachtet, ihre Embryonalentwicklung konnte erst kurze Zeit darauf verfolgt werden, als es gelang ganz ähnliche Eier im Plankton aufzufinden. Dieselben entließen nach kaum 2 Tagen kleine 2,3 mm lange Larven, deren Vorderkörper, von der Kopfspitze bis zum After 1 mm lang war. Die Augen waren noch farblos; je zwei gelbe Pigmentflecke lagen vor und hinter den Augen sowie hinter den Gehörblasen, ferner über dem After und auf der Mitte des Schwanzes; auf der Ölkugel waren einige wenige schwarze Farbzellen sichtbar; der After lag dicht am Hinterrand des Dottersackes. Die Weiterentwicklung der Larve ist erst später von M. Sella verfolgt worden[1].

Am 18. Juni wurden dann auf dem Markt von Palermo noch Thunfische mit zur Hälfte entleerten Geschlechtsdrüsen (♂ und ♀) gefunden. Von besonderer Bedeutung aber ist es, daß Sanzo noch später, nämlich am 25. Juni in Tonnaren der Provinz Siracus, die für den Fang der zurückwandernden Thunfische (tonni di ritorno) aufgestellt sind und dafür auch noch bis in den September hinein benutzt werden, Fische beobachten konnte, deren Eierstöcke wenig leerer waren als die um Mitte des Monats bei Palermo untersuchten. Sie enthielten noch reichlich Eier, die der Reife entgegengingen. Auch vom 27.—29. Juni wurden hier noch Fische beobachtet, deren Eierstöcke etwa zu einem Viertel gefüllt waren; und eine weitere allmähliche Abnahme der Geschlechtsdrüsen konnte bis Mitte Juli verfolgt werden. Erst von dieser Zeit ab erwies sich der Umfang der Eierstöcke als gleichbleibend.

Es ist Sanzo auch gelungen, bei Messina und Palermo eine Anzahl jugendlicher Thunfische in Größen von 34, 39, 44, 65, 68, 90 mm und darüber zu fangen, deren kleinsten er abgebildet hat, und er glaubt in diesen Jungen eine weitere Bestätigung der Tatsache erblicken zu sollen, daß der Thun in diesem Gebiet laicht.

Sanzo hat ferner an den in den Tonnaren gefangenen Thunfischen eine Reihe von Beobachtungen gemacht, auf Grund deren er sich berechtigt hält, Schlüsse über die Herkunft der Fische zu ziehen. Er bemerkt, daß sich die in einer Tonnara di posto gefangenen Fische, in welcher man den Fang für 3—4, auch 5—6 Tage ansammeln läßt, wie in einem Aquarium von oben her beobachten lassen, und daß er dabei eine auffallende Verschiedenheit im Ton der Rückenfarbe, die von dunkelschwarz bis zum hellen Blau wechselte, feststellen konnte. Er gibt nun der Überzeugung Ausdruck, daß die schwarzen Fische direkt aus tieferen Wasserschichten herstammten, während die heller gefärbten bereits Zeit gewonnen hätten, sich mit ihrer Farbe der stärkeren Belichtung in den höheren Wasserschichten anzupassen. Er geht freilich nicht so weit, mit Pavesi zu behaupten, daß die Tiefe, aus der die Fische kämen, in 1000 bis 1500 Faden zu suchen sei; er glaubt vielmehr, daß die Frage der Tiefe erst durch sorgfältige Magenuntersuchungen an

[1] Die Beschreibung paßt recht gut auf die von Holt (Ann. d. mus. d. Marseille 1899, Vol. V, 2, Fig. 18—21) zweifelnd als Charax puntazzo abgebildete Larve, doch sind die dazugehörigen Eier nach Holt (p. 114) nur 0,81 mm groß mit einem Öltropfen von 0,19, während die Maße der Larve ganz gut stimmen; auch Espèce III von Holt könnte in Betracht kommen.

solchen dunklen Fischen geklärt werden könne, die unmittelbar nach ihrem Eintreffen in der Tonnare vorgenommen werden müßten, und zwar möglichst bei solchen Tonnaren, die wie diejenige von Favignana, für den Zuzug der Thunfische aus den Tiefen des offenen Meeres besonders günstig gelegen seien.

Eine jüngere zusammenfassende Darstellung über das Verhalten des Thuns, welche zugleich Anspruch auf Originalität machen kann, obwohl ihr keine eigenen Untersuchungen zu Grunde liegen, verdanken wir dem Franzosen J. P. Bounhiol, dessen Beurteilung der Frage von den an der algerischen Küste gemachten Erfahrungen ausgeht. Er will nicht verkennen, daß man die alte Wandertheorie durch mancherlei Erweiterungen auch auf solche Tatsachen zurechtschneiden könnte, die ursprünglich nicht in sie hineinzupassen scheinen, z. B. indem man die ins Mittelmeer einwandernden Thunfische schon bei Gibraltar sich in eine größere längs der afrikanischen und eine kleinere längs der spanischen Küste gehende Gruppe teilen ließ und derartige Abzweigungen von der Hauptmenge auch an anderen Punkten annahm. So ließ sich auch die Mannigfaltigkeit der an den sizilianischen Küsten beobachteten Tatsachen durch die Annahme erklären, daß viele Thunfische nicht das ganze Mittelmeer umkreisten, sondern kleinere Kreise beschrieben um das westliche Mittelmeer oder auch nur um das Thyrrhenische Meer, desgl. durch die Behauptung, daß die Fische oftmals auf ihrer Wanderung kehrt machten, ohne den Kreislauf zu vollenden.

Einen sehr ernsten Widerspruch gegen die alte Theorie glaubt aber Bounhiol darin sehen zu können, daß der Thun im Ozean verhältnismäßig sehr viel seltener ist als im Mittelmeer. Freilich ist das nur in soweit richtig als der Thun im offenen Ozean nicht sehr häufig angetroffen wird, während er sich in der Bucht von Cadiz, also vor dem Eingang ins Mittelmeer, doch offenbar in so großen Massen ansammelt, daß er auch im Mittelmeer selbst kaum irgendwo dichter anzutreffen ist. Werden doch in der Bucht von Cadiz mindestens ebensoviel — wahrscheinlich aber mehr — Thunfische gefangen als im ganzen Bereich des Mittelmeeres!

Schwerwiegender ist aber zu Gunsten der Bounhiol'schen Darlegungen, daß gerade die zuverläßigsten Angaben über den Thun, die wir Gourret für den Golfe du Lion verdanken, beweisen, daß der Fisch als ständiger Bewohner des Gebiets zu allen Jahreszeiten angetroffen werden kann, was sich vermutlich noch weiter bestätigen lassen würde, wenn man die Beobachtungen noch mehr als bisher auf die offene See auszudehnen versuchte. Eine kaum geringere Bedeutung erblickt Bounhiol in der Tatsache, daß auch die jungen Thunfische sich zu verschiedenen Jahreszeiten und in allen Entwicklungsstufen im Mittelmeer antreffen lassen, daß sie also offenbar ebensowenig wie die Erwachsenen in den Ozean zurückkehren, sondern ihre ganze Entwicklung im Mittelmeer durchmachen.

Es steht ferner fest, daß die Thunfische an Orten gleichzeitig anwesend sind, an denen sie nur nach einander erscheinen könnten, wenn die alte Wandertheorie zu recht bestände, und daß sich die Geschlechtsreife der Fische an den verschiedenen Örtlichkeiten zu genau dem gleichen Zeitpunkt bemerkbar macht. Die nach der Theorie zu erwartende Reihenfolge im Auftreten an bestimmten Küstenpunkten erfährt nicht selten eine völlige Umkehrung oder wird durch eine mehr oder minder vollkommene Gleichzeitigkeit ersetzt. Aber auch wenn die zu erwartende Reihenfolge wirklich in die Erscheinung tritt, so beweist nichts, daß es sich an den dabei aufeinanderfolgenden oft in erheblichen Abständen liegenden Orten um dieselben Individuen handelt, und wäre letzteres der Fall, so müßten doch die Fänge an zuwandernden Fischen größer sein als die an abwandernden, was nach der vorhandenen Statistik oft ins Gegenteil verkehrt ist.

Nichts spricht übrigens auch dafür, daß die jungen — etwa einjährigen — Thunfische, die von Gourret bei Marseille, Bourge in Tunis, Sanzo bei Palermo und Bounhiol selbst in Algier im Frühjahr beobachtet wurden, das Mittelmeer schon verlassen gehabt hätten.

Während Bounhiol auf diese Weise die Zahl der Gründe vermehrt, die gegen eine Herkunft des Mittelmeerthuns aus dem Atlantik sprechen, und während er in der Hauptsache den Darlegungen von Pavesi und Sanzo beipflichtet, so glaubt er doch, daß der von diesen angenommene vorübergehende Aufenthalt des Thuns in großen (Pavesi) oder geringeren (Sanzo) Tiefen in den Tatsachen kaum genügende Stütze finde. Er meint, der Thunfisch würde schwerlich in den großen Tiefen die ihm zusagende Nahrung finden, und wenn er etwa die Temperaturschwankungen der höheren Wasserschichten vermeiden wollte, so würde er schon in 150 m Tiefe eine konstante Temperatur von 13—14° C finden. An der algerischen Küste ist sogar die in

ihren Temperaturverhältnissen stark veränderliche Oberflächenschicht nur 30—40 m mächtig, und bei Vermeidung dieser brauchte der Thun noch nicht auf die von ihm so bevorzugte Sardinen-Nahrung zu verzichten.

Andererseits würde selbst eine so geringe Tiefenveränderung, wie sie in diesen Zahlen begriffen ist, wahrscheinlich vollauf genügen, um die von Sanzo beobachteten Verschiedenheiten in der Färbung der Thunfische horvorzurufen; denn schon in 50 m Tiefe — namentlich nahe den Küsten — ist das Licht sehr schwach und in 100 m und tiefer herrscht andauernd fast völlige Nacht.

Es ist also wahrscheinlich, daß der Thun, wenn er sich im Frühjahr den Küsten nähert, zumeist vom offenen Meere herkommt; manchmal wird er dabei nahe der Oberfläche schwimmen, manchmal auch in etwas tieferen Schichten, wobei er dann dunklere Farben annehmen mag.

Aber wenn die Erwärmung des Wasser in Küstennähe eine der Ursachen ist, die den Thun anlocken, sei es weil er im wärmeren Wasser reichere Weideplätze findet, sei es weil er die vorhandene höhere Temperatur von 19 bis 22° C zur schnelleren Ausreifung und schließlichen Ablage der Geschlechtsprodukte braucht, so kann doch nach Bounhiol's Meinung das spätere wiederholte Auftauchen der Thunfische in Küstennähe nicht lediglich auf diese Weise erklärt werden. Der genannte Autor glaubt vielmehr, daß diese Bewegungen als mechanische Folge der Strömungen anzusehen sind, die im Wasser durch die jeweilig vorherrschenden Winde erzeugt werden, und die den Thun veranlassen, regelmäßig in einer diesen Winden entgegengesetzten Richtung vorzudringen. Bounhiol verweist darauf, daß die Eigenart der Küstenbildung, ihre Ausstattung mit vorspringenden Kaps, sowie Halbinseln und Inseln im Verein mit den herrschenden Winden für die örtlich zur Geltung kommenden Strömungen verantwortlich zu machen ist, und daß die Gesamtheit dieser Einflüsse — »le régime éolien et hydrodynamique local« — die Bewegungen der Thunfische an einem gegebenen Küstengebiet bedingt. Da wo zwei in der Richtung entgegengesetzte Strömungen regelmäßig im Laufe des Jahres miteinander abwechseln, wird man dann nach dem alten Sprachgebrauch mit einer »pêche de course« und einer »pêche de retour« zu rechnen haben.

Die von Bounhiol mit großem Nachdruck vertretene Auffassung stützt sich wesentlich auf die Deutung der an der algerischen Küste herrschenden Verhältnisse und versucht glaubhaft zu machen, daß die Dinge anderswo ebenso liegen müssen. Insonderheit wird hieraus die praktische Folgerung gezogen, daß der Thunfischfänger sich durch die sorgfältige Beachtung der Strömungen und der sie verursachenden Winde leiten lassen und ihnen folgend die Fische aufsuchen sollte, statt sich in der bisher üblichen, beinahe abergläubischen Weise auf die Erwartung der Thunfische an der Küste zu beschränken.

So beherzigenswert diese letztere Lehre erscheint, so braucht man sich doch nicht zu verhehlen, daß auch die von Bounhiol vorgetragene Hypothese — denn um mehr handelt es sich mangels ausreichenden Tatsachenmaterials kaum — nicht den Anspruch erheben kann, den Schlüssel für das höchst seltsam erscheinende Verhalten des Thuns darzubieten. Namentlich darf darauf hingewiesen werden, daß trotz aller lokal bemerkbaren Strömungen im Mittelmeer doch auch eine größere, die ganze Küstenlinie beherrschende Wasserströmung in einem der Bewegung des Uhrzeigers entgegengesetzten Sinne nachweisbar und noch neuerdings als bestehend bestätigt ist. Wenn jede Strömung im Wasser den von Bounhiol behaupteten Einfluß auf die Bewegung der Thunfische hätte, so müßte letztere eigentlich gerade entgegengesetzt sein, als sie es zufolge der Behauptung der alten Wandertheorie und im Hinblick auf die Regeln für die Aufstellung der Tonnaren in Wirklichkeit zu sein scheint.

Ein anderer französischer Autor, L. Roule, der sich in zahlreichen kleinen Veröffentlichungen in letzter Zeit mit der Biologie des Mittelmeer-Thuns beschäftigt hat, lehnt ebenfalls die Theorie von Bounhiol ziemlich bestimmt ab, um statt dessen die stenothermen und stenohalinen Neigungen des Thuns für alle rätselhaften Wanderbewegungen dieses Fisches verantwortlich zu machen, und zwar nicht nur in den Zeiten der Nahrungssuche, sondern auch — und in erhöhtem Maße — in der Zeit der Laichablage. Man kann darüber im Zweifel sein, ob dieser Versuch eine Verbesserung und einen Fortschritt in der Aufklärung des Sachverhalts bedeutet. Die Mehrzahl der modernen Ichthyobiologen wird kaum geneigt sein, mit Roule in der einseitigen Betonung der genannten physikalischen Verhältnisse die Lösung des Rätsels zu erblicken. Auch muß die Beweisführung unzulänglich bleiben, solange unsere Kenntnis von den Laichverhältnissen

und den Laichplätzen des Thuns so gering ist wie bisher. Beachtlich ist aber der gelegentlich von Roule angedeutete Gedanke, daß die Dichte des umgebenden Mediums mit guter Begründung in Beziehung zu den Bewegungen der Fische gebracht werden kann. Indessen fehlt der Hinweis, daß die Aufsuchung dichteren oder weniger dichten Wassers, je nach der Besonderheit eines Fisches, das Leitmotiv für die Entledigung von den Geschlechtsprodukten und damit der Anlaß zu vertikalen Bewegungen sein kann, die im Falle des Thunfisches von unten nach oben gerichtet sind, deren Existenz aber L. Roule zu bezweifeln scheint, da er immer nur von horizontalen Bewegungen spricht.

Weitere Aufklärungen sind, wie gesagt, von einer genaueren Kenntnis der Laichverhältnisse zu erwarten. In dieser Richtung bedeuten die neueren Beobachtungen von Odon de Buen in den spanischen Gewässern einen bescheidenen Schritt vorwärts. Er glaubt feststellen zu können, daß die Thunfische, die in großer Menge an der spanischen Südküste (Cadiz) gefangen werden — der Germon fehlt unter ihnen — beim Heranziehen von SW. kommend der Meerenge von Gibraltar zustreben, beim Abzug dagegen der portugiesischen Küste. Indessen scheinen sie die Meerenge nicht zu durchschwimmen; das Laichen findet vielmehr westlich derselben statt, und von dort sollen die Eier mit dem atlantischen Strom in das Mittelmeer hineingeführt werden und sich vor der marokkanischen Küste zwischen Punta Almina und Cap Tres Forcas anhäufen. In diesem Gebiet, das nordostwärts bis zur Insel Alboran reicht, und das durch hohe Temperatur, starken Salzgehalt und reiches Mikroplankton ausgezeichnet ist, wurden sehr große Larvenfänge gemacht und auch zahlreiche junge Thunfische in Größen von 1 bis $4^1/_2$ Kilogr. angetroffen. Leider ist in dem mir zur Verfügung gestellten Material von Johs. Schmidt dieses Gebiet so gut wie garnicht vertreten.

Wir kommen also bei diesem Überblick über die Theorien, die im Laufe der Zeit das Wesen der Wanderungen des Thunfisches zu erfassen gesucht haben, zu dem Schluß, daß eine völlig befriedigende Deutung der Erscheinungen einstweilen noch nicht erreicht ist, und daß man nur durch eine wesentliche Vermehrung des vorläufig doch nur bescheidenen Tatsachenmaterials hoffen darf, der Lösung des Rätsels in Zukunft näher zu kommen.

Bei unserer jetzigen Kenntnis von der Biologie des großen Thuns darf man behaupten, daß er in seinem Verhalten bei der Nahrungssuche und namentlich in seinen Laichwanderungen außerordentlich viel Ähnlichkeit zeigt mit der Makrele, daß er wie diese in der Tiefe heranzieht und zum Laichen aufsteigt, und daß vermutlich bei beiden Formen das Bedürfnis einer Anpassung an geringere Druckverhältnisse den Hauptantrieb zu dieser Vertikalwanderung gibt.

Wenn ich in der vorstehenden Erörterung der Lebensverhältnisse des Thuns im Mittelmeer sehr ausführlich geworden bin, so geschah das, um zu zeigen, wie weit die an sich recht schwierige Bestimmung der Thynniden-Larven in der Kenntnis dieser Dinge eine Stütze findet. Es ist klar, daß in den Monaten Mai, Juni, Juli mit dem Vorkommen der Larven beider Orcynus-Arten im Mittelmeer gerechnet werden muß, und daß die Larven des großen Thuns wahrscheinlich häufiger sind als die des weißen, während im Atlantik ein Überwiegen der letzteren zu erwarten ist.

Die Zugehörigkeit einer größeren Anzahl Larven unseres Materials zur Gattung Orcynus konnte außer durch den allgemeinen Habitus hauptsächlich durch die Wirbelzahl $18+21$ bestimmt werden. Diese Zahl, welche sich bei mehreren unserer Larven mit befriedigender Sicherheit feststellen ließ, wird von Valenciennes für den großen Thun angegeben. Dieselbe Gesamtwirbelzahl von 39 konnte Dr. Hugh M. Smith auf meine Bitte an einem Thunskelett im American Museum of Natural History, New York feststellen lassen, und $39 = 18+21$ wird neuerdings auch von Kishinouye für Orcynus orientalis Schleg. angegeben, welcher wahrscheinlich — aber nicht absolut sicher — als identisch mit unserem großen Thun anzusehen ist.

Dagegen lassen sich für Orcynus germo nur sehr wenig Wirbelzählungen ausfindig machen, unter denen die Angaben von Valenciennes mit $19+21$ oder $20+20=40$ besonders erwähnenswert erscheinen. E. Ch. Starks gibt für ein Exemplar von der kalifornischen Küste dieselbe Gesamtzahl (40), K. Kishinouye aber zählt $18+21$ — also wie beim großen Thun, wie er denn überhaupt versichert, daß die Wirbelzahl bei den Angehörigen der Gattung Orcynus übereinstimmend 39 sei, ebenso wie bei allen Scomberarten

übereinstimmend 31. Die Wirbelzahl des Germon ist also offenbar derjenigen beim großen Thun sehr ähnlich und höchstens um einen Wirbel verschieden, wahrscheinlich aber ganz gleich.

Ich zweifle nicht, daß die diesbezügliche Angabe von KISHINOUYE richtig ist, nicht nur weil ihm offenbar das reichhaltigste und sorgfältig präparierte Material zur Verfügung gestanden hat, sondern auch weil in unserem Larvenmaterial zwei Formen unterscheidbar sind, die beide die Wirbelzahl 18+21 besitzen und außerdem durch eine Reihe von Charakteren auf ihre Zugehörigkeit zur Gattung Orcynus hinzudeuten scheinen. Allerdings bleibt zunächst zweifelhaft, welche von diesen beiden Formen dem großen Thun und welche dem Germon zuzuzählen ist, weil das Hauptunterscheidungsmerkmal der erwachsenen Stadien, welches in der Länge der Brustflossen liegt, noch nicht in definitiver Form ausgebildet ist, und weil die in den Flossenstrahlen gegebenen Zahlenverhältnisse auch noch nicht für die Unterscheidung der beiden Thunfischarten zu gebrauchen sind. Die Übereinstimmung in diesen Zahlen ist auch bei den erwachsenen Fischen eine sehr weitgehende, und der einzige leichter erkennbare Unterschied, daß nämlich beim Germon drei Stachelstrahlen am Anfang der 2. Rückenflosse stehen, beim großen Thun dagegen nur einer mit 12 bezw. 13 nachfolgenden Weichstrahlen, dürfte zur Erkennung der Larvenformen kaum zu verwerten sein, zumal die Gesamtzahl der Flossenstrahlen in der 2. Dorsale durch die Zahl der Flößchen, die bei der Larve auch als einfache Flossenstrahlen erscheinen, einen vollkommenen Ausgleich erfährt. Folgende Zahlen dürfen als normal angesehen werden: für Orcynus thynnus: 2. D = 1/13+IX

» » germo: 2. D = 3/12+VIII.

In Ermangelung eines zuverlässigen Unterscheidungsmerkmals habe ich mich nun entschloßen, die im Mittelmeer häufigere Larvenform dem großen Thun, die im Atlantik häufigere dem Germon zuzuteilen. Das kann mit Recht als unzulässig bezeichnet werden; aber ich tue es auf die Gefahr hin, eine spätere Korrektur zu erfahren; übrigens finde ich, daß CHR. LÜTKEN bei der Zuteilung der von ihm abgebildeten atlantischen Thunlarven, die nur zweifelnd erfolgen konnte, anscheinend auch keine besseren und zuverlässigeren Anhaltspunkte haben konnte.

Durch das freundliche Entgegenkommen des Direktors des Zoologischen Museums zu Kopenhagen wurden mir auf meine Bitte sechs Fänge von Thynniden Larven zugesandt, welche s. Zt. CHR. LÜTKEN vorgelegen haben und von ihm bei seiner Beschreibung und seinen Abbildungen benutzt wurden. Dieselben stammen, wie schon erwähnt, von den verschiedensten Punkten der Weltmeere, wennschon hauptsächlich aus dem Atlantik; sie sind meist über 50 Jahre alt und demzufolge ziemlich mangelhaft erhalten. Indessen hat dieser letztere Fehler wahrscheinlich in nicht geringem Maße schon bestanden, als LÜTKEN seine Untersuchung vornahm, und es ist wohl hierauf zurückzuführen, daß er die unter dem Larvenmaterial offenbar vorhandenen verschiedenen Arten nicht zu unterscheiden vermochte und außerdem in seinen Abbildungen gewisse abgebrochene Flossenstrahlen in abnormer Kürze dargestellt hat. Der letztere Umstand veranlaßt KISHINOUYE (p. 384) daran zu zweifeln, daß die von LÜTKEN abgebildeten Larven überhaupt als »Plecostei« oder gar als O. germo anzusehen seien, und sie vielmehr für Entwicklungsformen von Cybiumarten zu halten, weil der erste Dorn der 1. D. auffallend kürzer sei als die folgenden. Dies ist in den LÜTKEN'schen Abbildungen allerdings der Fall, hat aber gar keine Bedeutung, da es sich um Verstümmelungen dieser Flosse handelt, während andererseits die sonstigen Eigenschaften der Larven ihre Zugehörigkeit zu Orcynus über allen Zweifel erheben. Allerdings ist sehr bemerkenswert, daß die beiden von LÜTKEN abgebildeten Stadien von 17 und 10 mm wahrscheinlich nicht derselben Art angehören, sondern das größere zu der von mir hier als O. germo charakterisierten Form und das kleinere zu O. thynnus. Diese Verschiedenheit ist aus den Abbildungen allerdings nicht mehr zu erkennen.

Ehe ich auf die Beschreibung der einzelnen von mir untersuchten Larvenformen eingehe, schließlich noch ein Wort über die neueren Mitteilungen von M. SELLA über die Orcynusarten. Dieser Autor hat an Material, welches zum größten Teil aus sizilianischen Tonnaren aber auch aus anderen Quellen stammte, die Unterscheidung der beiden Orcynusformen mit Hilfe des Körperpigments durchzuführen gesucht; er gibt an, daß bei den Larven von O. germo das Pigment auf dem Hinterkörper vollständig fehlt, während es bei O. thynnus durch einige Punkte vertreten ist. Es ist indessen aus der Darstellung nicht ersichtlich,

worauf sich die Benennung der Formen gründet, und das Fehlen von Abbildungen ermöglicht mir nicht, diesem Autor zu folgen. Ich glaube, daß die von ihm als O. germo charakterisierte Form wirklich ein Orcynus ist, vielleicht sogar O. germo, wahrscheinlicher aber O. thynnus. Dagegen halte ich seinen O. thynnus nicht für richtig bestimmt. Ich vermute vielmehr dahinter einen Euthynnus alliteratus. Ich kann indessen mit dieser Auffassung nur eine Vermutung aussprechen und möchte die Entscheidung über deren Richtigkeit einer neuen Untersuchung an einwandfreiem und lückenlosem Material vorbehalten.

Als gemeinsame Charakteristik der Orcynuslarven kann folgendes angegeben werden.

Wirbelzahl 18 + 21, sehr großer Kopf, der namentlich bei den jüngeren Stadien über $^2/_5$ bis nahezu $^1/_2$ der Gesamtkörperlänge — unter Abrechnung der Schwanzflosse — ausmacht; Mundspalte entsprechend groß mit kräftigen Zähnen, deren Zahl allmählich zunimmt; einige wenige Gaumenzähne jederseits; After weit nach vorn belegen.

Die Entwicklung der Flossenstrahlen beginnt bei sehr geringer Körpergröße; namentlich auffallend ist das frühe Hervortreten der 1. D., welche mindestens ebenso früh wenn nicht früher als die andern unpaaren Flossen ihre Strahlen entwickelt. Die Strahlen der 1. D. wachsen sehr schnell zu erheblicher Länge heran und lassen frühzeitig dichtes schwarzes Pigment auf ihren Häuten erkennen.

ORCYNUS GERMO LACÉP. (?)

Unter unserem Material befinden sich zwei große Thynnidenlarven von 13,5 (im frischen Zustand etwa 15) mm Länge. Beide wurden im Atlantik gefangen, nämlich

1. bei St. 292, Sargasso Meer, 25° N 56° W, am $^{17}/_5$ 1911 durch S. S. St. Croix mit 47 m Leine.
2. bei St. 819, östlich von St. Thomas, 19° 10′ N 61° 4′ W, am $^{23}/_6$ 1915 durch S. S. Tranquebar, mit 170 m Leine.

Beide Fischchen sind durch die Größe des Kopfes ausgezeichnet, dessen Länge 5, dessen Höhe 3,8 mm beträgt, ferner durch große dunkle Augen und eine schwarz pigmentierte sehr hohe erste Rückenflosse. Die Zählung der Flossenstrahlen und der Wirbel ergibt folgende Zahlen:

St. 292 D: 14 + 14 + IX A.: 14 + VIII Vert: 18 + 21,
St. 819 D: 13 + 13 + IX A.: 13 + VIII Vert: 18 + 21.

Fig. 4. Orcynus germo Lacép. (?) Mitte Atlantik (St. 348) 4. IX. 1911. 12,0 mm lang. Vergr. 10,0 ×.

Das erstere der beiden Exemplare ist in Fig. 4a wiedergegeben. Ein weiteres fast ebenso großes und den vorigen sehr ähnliches Exemplar wurde bei St. 348 in der Mitte des Atlantik am 4. IX. 1911 erbeutet. Es war 12 mm lang und sein in Fig. 4 abgebildeter Vorderkörper zeigt in seiner Ausbildung eine weitgehende Übereinstimmung mit den wenig größeren Exemplaren.

Zur Charakteristik dieser Stadien sei folgendes bemerkt. Die erste Rückenflosse ist wesentlich höher und ihre Basis länger als die der zweiten (ungerechnet die Flößchen). Der erste Flossenstrahl der 1. D. ist nur wenig kürzer als der 2. und 3., welche die längsten sind. Nach hinten gelegt reichen die langen Strahlen bis nahe an den Anfang der 2. D. Die letzten Strahlen der 1. D. sind noch klein und nicht immer deutlich, ihre Stellung ist derart, daß sie ebensogut als erste Strahlen der 2. D. gelten könnten. Alle Strahlen der 1. D. sind in eine Längsrinne der Haut niederlegbar, welche bereits deutlich ist. Das Pigment der 1. D. ist nicht in Gestalt von sternförmigen Chromatophoren vorhanden, sondern in dichten tiefschwar-

zen Massen auf den Flossenhäuten, welche im vorderen Teil der Flosse näher an deren distalem Ende oder in der Mitte liegen, im hinteren Ende jedoch näher dem proximalen Teil, dabei auf den Körper des Fischchens übergreifend.

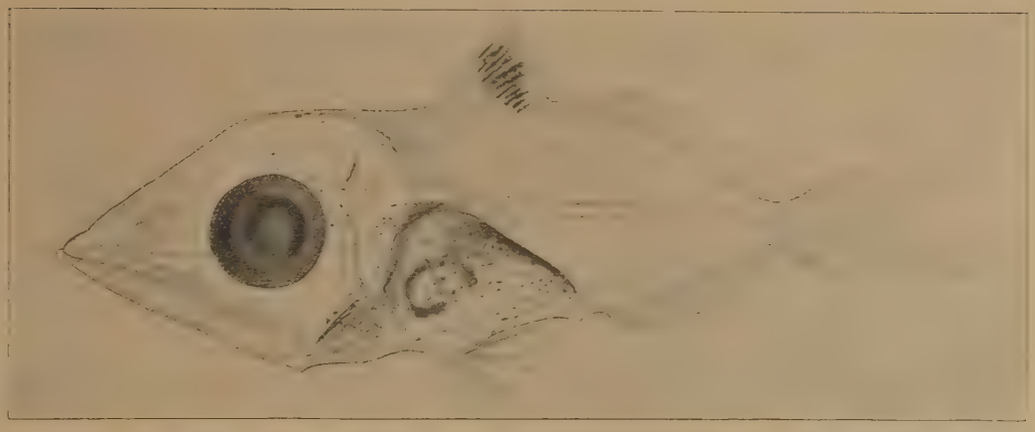

Fig. 4a. Orcynus germo Lacép. (?) Sargassomeer (St. 292) 17. V. 1911. 13,5 mm lang. Vergr. 10,0 ×.

Die Flößchen sind sämtlich angelegt, wenn auch die letzten nur angedeutet sind; sie sind sowohl in der 2. D. wie in der Afterflosse den Flossenstrahlen so gleich gebildet, daß eine scharfe Trennung beider Gruppen kaum möglich ist.

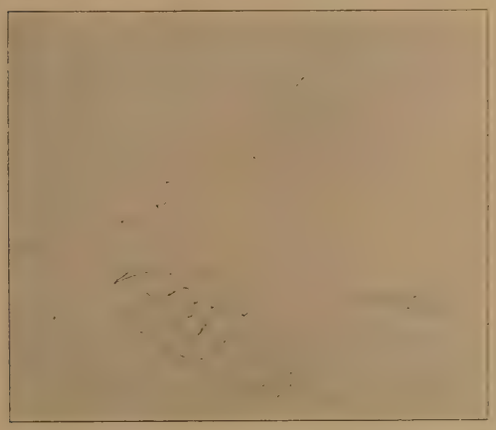

Fig. 4b. Orcynus germo Lacép. (?). O. v. St. Thomas (St. 819) 23. VI. 1915. 13,6 mm lang. Vergr. 15,0 ×.

Die Schwanzflosse ist wohl ausgebildet und tief ausgeschnitten. Die Bauchflossen sind vollkommen entwickelt; ihre längsten Strahlen reichen nicht völlig bis zum After nach hinten; letzteres gilt in noch höherem Grade von den Brustflossen, welche nur einen kleinen Teil des Eingeweidesacks bedecken und im Hinblick auf ihre spätere außerordentliche Länge auffallend kurz erscheinen.

Der Abstand des Afters von dem Ansatz der Afterflosse ist sehr gering und beträgt nur etwa 0,3 mm; der After liegt schon im Beginn des letzten Körperdrittels — ungerechnet die Schwanzflosse. Kopf: Die Mundspalte ist sehr lang, sodaß der Hinterrand des Oberkiefers unter dem hinteren Drittel des Auges liegt. Auf den Kiefern stehen zahlreiche kräftige und spitzige Zähne ziemlich gleichmäßig verteilt, im Ganzen etwa 20 bis 24 jederseits oben und unten, von denen jedoch mehrere noch sehr klein sind. Die vordersten Zähne des schnabelartigen Praemaxillare greifen mit diesem über den Unterkiefer hinweg. Längs des Gaumens sind jederseits 5 bis 10 größere und kleinere Zähne sichtbar.

Die beiden Narinen sind von einander getrennt, die vordere ist mit einer fünfteiligen Rosette versehen.

Von besonderer Bedeutung ist die Bewaffnung des Praeoperculum (fig. 4 b): hinter einer niedrigen crista mit 3 kleinen Zähnchen ist der in 9 bis 10 Spitzen ausgezogene Rand des Knochens sichtbar, an der Ecke stehen zwei große und ziemlich breite Dornen, welche beide etwa 0,5 mm lang sind, am unteren Ast zählt man 4 bis 5 kleine Spitzen, welche nach vorn hin

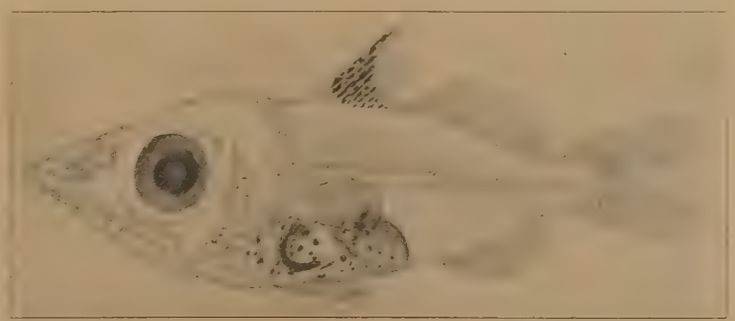

Fig. 4c. Orcynus germo Lacép. (?) Cap Matapan (St. 340) 26. VIII. 1911. 11,2 mm lang. Vergr. 9,0 ×.

(zum Mundwinkel) kleiner werden, am oberen Ast 2 bis 3 ebenfalls kleine Dornen. Die größeren Dornen an der Ecke überragen nach hinten den kräftigen Schultergürtel, von dessen Mitte das Clavicularstyloid (Postclavicula) abzweigt, nach hinten und unten den Eingeweidesack reifenartig umfassend.

Der Eingeweidesack erscheint schon erheblich in die Länge gezogen, auf seiner dorsalen Kuppe ist die ovale Schwimmblase sichtbar; das Peritoneum ist dicht — und am stärksten in seinem dorsalen Teil — mit tiefschwarzen Pigmentsternen übersät, welche auch in die Kehlgegend und Schläfengegend ausstrahlen. Die Nackenpartie und anschließend die Rückenmuskulatur bis zum Ansatz der 2. D. ist ebenfalls mit zahlreichen aber viel feineren Pigmentpünktchen bedeckt. Außerdem strahlen vom Kopf her Chromatophorenzüge die Wirbelsäule begleitend in den im Übrigen ganz pigmentlosen Hinterkörper aus.

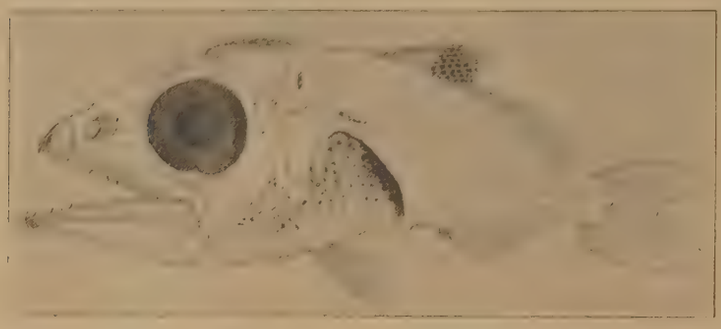

Fig. 4d. Orcynus germo Lacép. (?) O. v. St. Thomas (St. 819) 23. VI. 1915. 10,0 mm lang. Vergr. 10,0 ×.

An diese drei größten schließt sich nun eine ganze Reihe jüngerer Exemplare an, die sich mit jenen in Zusammenhang bringen lassen.

Als Repräsentanten der nächsten Größenstufen sind in Fig. 4c und 4e[1] Jungfische aus dem Mittelmeer abgebildet worden, die 11,2 und 9,5 mm lang sind und am 26. 8. 1911 südwestlich von Cap Matapan gefangen wurden. (St. 340), und in Fig. 4d ein etwa gleich großer von 10 mm, der am 23. 6. 15 östlich von St. Thomas erbeutet wurde. (St. 819).

Auch bei diesen Exemplaren läßt sich die Wirbelzahl zu 18 + 21 feststellen. Die tief schwarz pigmentierte 1. D. erscheint verhältnismäßig noch größer als bei den größeren Exemplaren. Der 1. Flossenstrahl ist etwa 1,5, der zweite und dritte etwa 1,6 bis 1,7 mm lang, sie reichen niedergelegt bis über den Anfang der 2. D. hinaus. Von Strahlen sind in der 1. D. auf diesem Stadium meist nur 10 bis 12 erkennbar, da die letzten noch nicht entwickelt sind. Auch die Anlage der letzten Flößchen — dorsal sowohl wie anal — ist oft nur mit Mühe erkennbar.

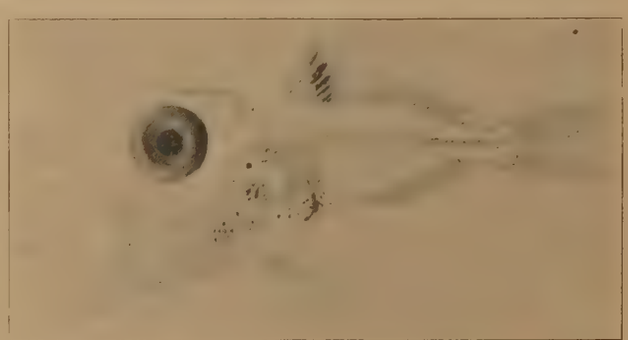

Fig. 4e. Orcynus germo Lacép. (?) Cap Matapan (St. 340) 26. VIII. 1911. 9,5 mm lang. Vergr. 9,0 ×.

Die Schwanzflosse ist lang und tief ausgeschnitten. Brustflossen und Bauchflossen reichen weit auf den Eingeweidesack nach hinten, aber nicht bis an die Vertikale des Afters.

Der Abstand des Afters von der Insertion der Afterflosse ist gering.

Der Kopf der Larve ist unverhältnismäßig groß und nimmt etwa $^3/_7$ bis fast $^1/_2$ der Totallänge ein (ungerechnet die Schwanzflosse). Der Oberkiefer greift über den unteren hinweg, und in beiden sind jederseits etwa 18 bis 20 spitzige Zähne vorhanden, außerdem jederseits 5 bis 7 größere und kleinere Gaumenzähne. In den Kieferspitzen ist bisweilen etwas dunkles Pigment sichtbar.

Die Bedornung des Praeopercularrandes ist derjenigen der größeren Fischchen sehr ähnlich und ist etwa durch die Ziffern 4 + 2 + 3 auszudrücken (Fig. 4b), sodaß der horizontale Ast oft eine Spitze weniger besitzt als bei den vorerwähnten größeren Exemplaren. Die beiden größten Dornen haben eine Länge von etwa 0,5 mm und reichen bisweilen bis auf den Eingeweidesack nach hinten. Dieser letztere erscheint kürzer und gedrungener als bei den größeren Larven und auch weniger dicht pigmentiert.

[1] Für Figur 4e kommt vielleicht Zugehörigkeit zu Orcynus thynnus in Betracht; nur der geringe Analabstand spricht dagegen.

Der eigentliche Körper der Larve entbehrt des Pigments noch mehr oder weniger ganz, nur im vorderen Teil der Wirbelsäule, sowie im Nacken unter der 1. D. sind bisweilen Anfänge von Pigmententwicklung sichtbar.

Ein etwas jüngeres Entwicklungsstadium von ca. 7 mm Länge ist in der Figur 4f wiedergegeben; es entstammt dem schon erwähnten Fange vom 23. 6. 1915 östlich von St. Thomas (St. 819).

Trotz der außerordentlich geringen Körpergröße der Larve zeigt die 1. D. eine gewaltige Entwicklung sowohl in ihrer Größe wie in der Massigkeit der Pigmentierung. Die längsten Strahlen reichen bereits erheblich über die Insertion der 2. D. nach hinten; im Ganzen sind 9 Strahlen erkennbar, während sich in der 2. D. und in der Anale — mit Einschluß der teilweise entwickelten Flößchen — etwa je 20 Elemente zählen lassen. Diese beiden letzteren Flossen scheinen hinter der 1. D. in der Entwicklung zurückzustehen. Der Abstand der Analflosse vom After ist ungefähr der gleiche wie bei einer 8,5 mm langen Larve desselben Fundorts.

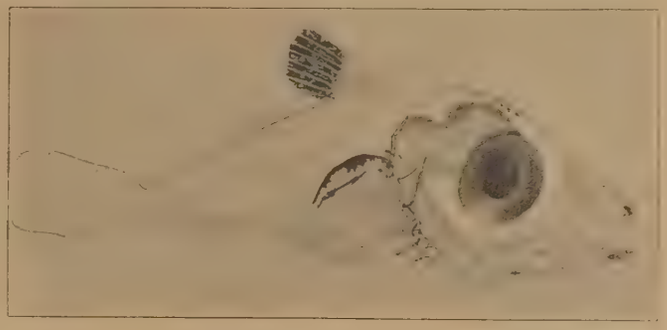

Fig. 4f. Orcynus germo Lacép. (?) Ø. v. St. Thomas (St. 819) 23. VI. 1915. 7,0 mm lang. Vergr. 13,0 ×.

Die paarigen Flossen sind verhältnismäßig gut entwickelt; Brustflossen sowohl als Bauchflossen reichen bis zum After nach hinten. Die Schwanzflosse ist endständig und am hinteren Rande leicht eingekerbt.

Die Größenverhältnisse des Kopfes sind ungefähr dieselben wie bei der vorher beschriebenen größeren Larve; die Nasenlöcher sind noch nicht voneinander getrennt, Zähne sind in den Kiefern jederseits oben und unten etwa 15 vorhanden, während sie im Gaumen noch fast gänzlich fehlen; nur links ist ein vereinzelter Gaumenzahn sichtbar. In den Kieferspitzen ist Pigment vorhanden.

Die Präoperkularbewaffnung zeigt deutlich eine frühere Entwicklungsstufe als vorher beschrieben, nur die 3 Dornen auf der crista gleichen in Ausbildung und Stellung denen der späteren Entwicklungsstufen. Von den Randdornen tritt besonders der mittelste durch seine Länge und Schlankheit hervor; er ragt bis weit auf den Eingeweidesack hinauf, und ist jederseits von einem mittelgroßen auch noch ziemlich schlanken Dorn flankiert, dem am horizontalen Ast nach vorn 2 und am vertikalen Ast nach oben 1 kleinerer Dorn folgen.

Fig. 4g. Orcynus germo Lacép. (?) Cap Matapan (St. 340) 26. VIII. 1911. 5,8 mm lang. Vergr. 15,0 ×.

Der Eingeweidesack erscheint sehr hoch und von vorn nach hinten zusammengepreßt, auf seiner Kuppe liegt die sehr große Schwimmblase; über ihm verläuft jederseits das Clavikularstyloid. Pigment ist nur im vorderen Teil des Eingeweidesackes und in der Umhüllung der Schwimmblase ausgebildet; im übrigen Körper fehlt es noch.

Obwohl es zweifelsohne noch kleinere Larven mit wohlausgebildeter und dunkelpigmentierter 1. D. geben muß, so fehlen dieselben doch unter unserem Material.

Schon die nächste Größenstufe, welche mit 6 mm Totallänge nur um 1 mm kleiner ist als die zuletzt beschriebene, läßt schwarzes Pigment in der 1. D. nicht mehr erkennen, obwohl die Strahlen dieser Flosse in der frühesten Anlage sichtbar sind. Zwei solche Exemplare, die wahrscheinlich hierher zu rechnen sind, wurden mit dem in Fig. 4a abgebildeten größten Exemplar auf St. 292 (Sargassomeer) erbeutet. Sie sind abgesehen von einigen Chromatophoren im Peritoneum und in der Schläfengegend noch ganz pigmentfrei, lassen etwa 10 Kieferzähne jederseits oben und unten und manchmal auch einen ver-

einzelten Gaumenzahn erkennen, Präoperkulardornen in der beim 7 mm langen Stadium beschriebenen Zahl und Anordnung und Strahlen in den unpaaren Flossen nur andeutungsweise.

Ein noch kleineres gleichzeitig gefangenes Exemplar von 5,0 mm Länge stellt mit drei etwa gleich großen Individuen von 4,6 bis 5.8 mm Länge von der St. 340, welche noch ohne Strahlenbildung in der 1. D. sind, die jüngsten uns bisher bekannt gewordenen Stadien dieser Entwicklungsreihe dar.

Diese kleinsten Larven (Fig. 4g und 4h) haben ein mehr oder weniger aufgebogenes Urostyl, unter dem die Schwanzflosse noch nicht ganz endständig, aber doch auf dem Wege dazu ist. Die übrigen unpaaren Flossen sind in der Entwicklung ebenso sehr zurück wie die 1. D., höchstens ist in der Anale eine Andeutung ihrer späteren Lage zu sehen, wobei ihre Insertion in auffallend großer Entfernung vom After erscheint. Die Brustflossen reichen bis zur Senkrechten des Afters nach hinten, die Bauchflossen sind noch Knospen oder sehr klein, aber doch verhältnismäßig frühzeitig entwickelt.

Der Kopf besitzt noch nicht die unverhältnismäßige Größe wie in späteren Stadien. Zähne sind etwa 7—10 jederseits oben und unten vorhanden. Die Präoperkulardornen zeigen die früher beschriebene Anordnung mit dem weit auf den Eingeweidesack hinaufreichenden mittleren längsten Dorn; aber sowohl der unterste (vorderste) wie der oberste Dorn können fehlen oder noch winzig klein sein. Pigment ist nur auf dem Eingeweidesack und ein wenig auch in der Gehirngegend vorhanden.

Fig. 4h. Orcynus germo Lacép. (?) Cap Matapan (St. 340) 26. VIII. 1911. 4,5 mm lang. Vergr. 18,0 ×.

Daß es sich in diesen kleinen Larven um Orcynus handelt, ist kaum zu bezweifeln, doch hat die Annahme, daß es Orcynus germo seien, keine andere Begründung als die, daß am gleichen Orte eine Anzahl größerer und älterer Entwicklungsstadien von O. germo gefangen wurden.

Versucht man, eine allgemeine Charakteristik der Larven von Orcynus germo und der Veränderung ihrer hauptsächlichen Merkmale im Laufe der Entwicklung zu geben, so läßt sich etwa folgendes sagen.

Die 1. D. ist frühzeitig und vor den anderen D.- und A.-Flossen entwickelt; sie nimmt sehr schnell eine so große Höhe an, daß ihre Strahlen niedergelegt über die Insertion der 2. D. nach hinten reichen (7—12 mm Länge) und erst später, bei der Streckung der Larve (13 mm) den Anfang der 2. D. nicht mehr ganz erreichen, obwohl sie andauernd sehr lang bleiben. Auch die Färbung der Flossenhaut in der 1. D. macht sich frühzeitig bemerkbar, und ist meist sehr intensiv.

Die paarigen Flossen reichen zunächst bis zum After nach hinten, später bei 11 mm und darüber, jedoch nicht mehr, da dann der Eingeweidesack erheblich an Ausdehnuug gewinnt und den von Anfang an nicht sehr großen postanalen Raum noch weiter verkleinert.

Die Zahl der Praeoperkular-Dornen vergrößert sich im Laufe der Entwicklung von 2 + 2 + 1 auf 5 + 2 + 3, wobei der unterste der mittleren Dornen der größte bleibt, aber alle und namentlich die mittleren sich allmählich abstumpfen. Gaumenzähne sind frühzeitig angedeutet; ihre Zahl vermehrt sich allmählich bis auf 10 (bei 13 mm).

Ein Überblick über die Fundorte, an denen Entwicklungsformen der hier beschriebenen Orcynus Art festgestellt werden konnten, zeigt, daß dieselben mit einer Ausnahme alle im Atlantik liegen und zwar meist im mittleren und westlichen Teil des mittleren Atlantik; die nördlichste und östlichste Station ist St. 348 bei 30° 45′ N 41° 50′ W, außerdem liegt eine Station vor der Brasilianischen Küste bei Pernambuco und eine im östlichen Mittelmeer südlich Cap Matapan.

Der Zeit nach fällt ein Fang — der an der brasilianischen Küste — in den April, einer in den Mai, zwei ziemlich ergiebige in den Juni, zwei, — darunter der Mittelmeerfang als ergiebigster von allen — in den August und einer Anfang September.

Verzeichnis der beobachteten Larven von Orcynus germo.

J. Nr.	Zeit	Ungefähre Ortsangabe	Länge der Leine	Zahl der Larven	Größe in mm	Bemerkungen
292	$^{17}/_{5}$ 11	Sargassomeer	47 m	1 + 3	13,5; 6,0; 6,0; 5,0.	Fig. 4 a
336	$^{27}/_{7}$ 11	»	30 -	1	10,2	
340	$^{26}/_{8}$ 11	Cap Matapan	108 -	8	11,6; 11,2; 9,0; 8,4. 8,0; 5,8; 5,4; 4,6.	Fig. 4 c, e, g, h.
348	$^{4}/_{9}$ 11	Mitte des Atlantik	35 -	2	12; 9.	Fig. 4
472	$^{11}/_{4}$ 12	Brasilianische Küste	15 -	2	8,8; 5,0.	
494	$^{16}/_{5}$ 12	Atlantik	85 -	3	9,1; 8,2; 7,8.	
817	$^{21}/_{6}$ 15	»	170 -	4	11,9; 10,5; 9,0; 8,5.	
819	$^{23}/_{6}$ 15	O. v. St. Thomas	170 -	4	13,6; 10,0; 8,4; 7,1.	Fig. 4 b, d, f.

ORCYNUS THYNNUS L. (?)

Die zweite in unseren Sammlungen vertretene Thunfischart, welche ich als Orcynus thynnus L. anspreche, findet sich leider nicht in so großen Exemplaren wie die erstbeschriebene.

Die größte Larve, auf deren Untersuchung sich die Zuteilung gründet, ist etwa 9,4 mm lang und wurde vom »Thor« bei Station 192 unweit Messina am 20. VIII. 1910 erbeutet. Sie ist ziemlich gut erhalten und in Fig. 5a abgebildet. Die genaue Wirbelzählung scheitert an der Schwierigkeit die Grenze zwischen Rumpf- und Schwanzwirbeln festzustellen, doch führt sie mit leidlicher Sicherheit auf 18 + 21 = 39, und dieses Merkmal im Verein mit einer Reihe weiterer gleich zu erwähnender veranlaßte die Zuteilung zu Orcynus. Ins Auge fallend sind der gedrungene Körper, der große Kopf, die kräftige Bezahnung der Kiefer und Bewaffnung des Präoperculum, eine früh und stark entwickelte 1. D. mit dunklem Pigment, grosser Abstand der Analflosse vom After u. a. m.

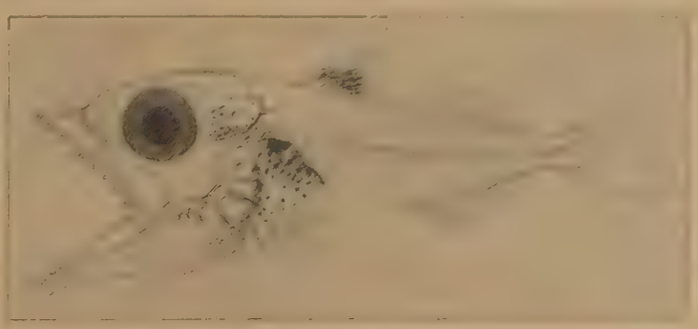

Fig. 5a. Orcynus thynnus L. (?) Messina (St. 192) 20. VIII. 1910. 9,4 mm lang. Vergr. 10,0 ×.

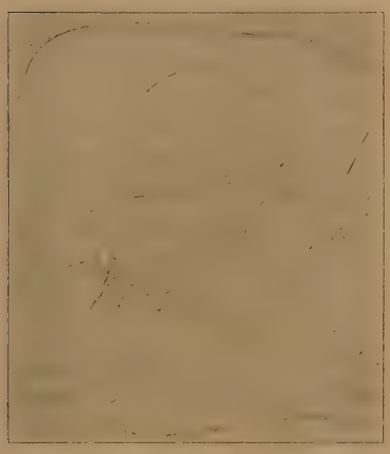

Fig. 5b. Orcynus thynnus L. (?) O. v. Cap Spartivento (St. 187) 18. VIII. 1910. 9,3 mm lang. Vergr. 22,0 ×.

Die Flossen sind in ganz ähnlicher Weise entwickelt wie bei O. germo, indessen ist die 1. D. weniger hoch, und ihre niedergelegten Strahlen reichen nicht bis zum Anfang der 2. D. oder darüber hinaus; auch sind die Flossenhäute zwischen den Strahlen zwar pigmentiert, aber nicht entfernt so dunkel wie bei O. germo. Die Zahl der erkennbaren Strahlen beträgt nur 12; doch ist der Flossensaum zwischen dem 12. Strahl und der 2. D. groß genug, um die Entwicklung von noch 2 weiteren Strahlen zu gestatten. Die Träger des 1. und 2. Strahls greifen wie bei O. germo zwischen den Spinalfortsätzen des 2. und 3. Wirbels ein. In der 2. D. und in der weit hinter dem After ansetzenden Afterflosse lassen sich etwa je 12 + VIII Strahlen zählen, von denen letztere acht die Vorläufer der Flößchen bilden. Die Schwanzflosse ist beschädigt, war aber offenbar am Hinterrande schon eingebuchtet. Die paarigen Flossen sind ziemlich groß und erreichen nach hinten gelegt den After. In den Kiefern lassen sich jederseits oben und unten etwa 18 kräftige Zähne zählen und daneben im Gaumen jederseits etwa drei. Die Narinen sind

noch konfluent. Die Präoperculardornen sind durchweg kräftig entwickelt und zeigen folgende Anordnung: In der Mitte steht der längste, welcher über den Schultergürtel nach hinten und auf den Eingeweidesack hinaufreicht; jederseits von diesem steht je ein mittellanger Dorn und anschließend daran nach oben 2 kleinere, nach unten und vorn 2 bis 3 (rechts 2, links 3) allmählich an Größe abnehmende (vgl. fig. 5b).

Fig. 5c. Orcynus thynnus L. (?) O. v. Cap Spartivento (St. 187) 18. VIII. 1910. 9,3 mm lang. Vergr. 9,0 ×.

Auf der Otocyste ist ein dreiteiliger Temporaldornenkamm sichtbar.

Der Eingeweidesack ist kurz und gedrungen, triedrisch und dorsal von der kleinen Schwimmblase gekrönt, nach hinten und oben von den Brustflossen überragt. Er ist reichlich mit Pigment versehen, das auch in verschiedenen Teilen des Kopfes nicht fehlt, sonst aber und namentlich auf dem Hinterkörper noch ganz vermißt wird.

Der eben beschriebenen Larve in vielen Punkten ähnlich ist eine fast genau gleich große (9,3 mm), welche am 18. 8. 10 auf Station 187 d. i. im Jonischen Meer östlich von Cap Spartivento, durch »Thor« erbeutet wurde und in Fig. 5c abgebildet ist. Die Flossen sind in gleicher Weise, wie vorher beschrieben, entwickelt; die lebhaft pigmentierte 1. D. läßt deutlich 8 und annähernd noch weitere 3 Strahlen erkennen; die ziemlich gut erhaltene Schwanzflosse ist am hinteren Rande nur leicht eingekerbt. Aber in einem Punkte unterscheidet sich diese Larve sehr auffällig von der vorher beschriebenen, und zwar in dem wesentlich kürzeren Postanalraum, der bei Fig. 5c nur etwa halb so lang ist als bei Fig. 5a. Dieser nicht zu übersehende Unterschied erscheint so groß, daß ich zunächst glauben mußte, es handle sich um zwei verschiedene Arten. Indessen führte eine wiederholte Prüfung doch zu der Überzeugung, daß die Larve 5c trotz gleicher Länge einen etwas späteren Entwicklungszustand darstellt als 5a. Bei dieser Größe von etwa 9,5 mm vollzieht sich offenbar ein Umwandlungsprozeß, durch den der Eingeweidesack erheblich an Längenausdehnung gewinnt, der After entsprechend nach hinten verschoben und der postanale Raum zwischen After und Afterflosse verkleinert wird, während gleichzeitig die Größe der paarigen Flossen im Verhältnis zur Länge des Eingeweidesackes reduziert erscheint.

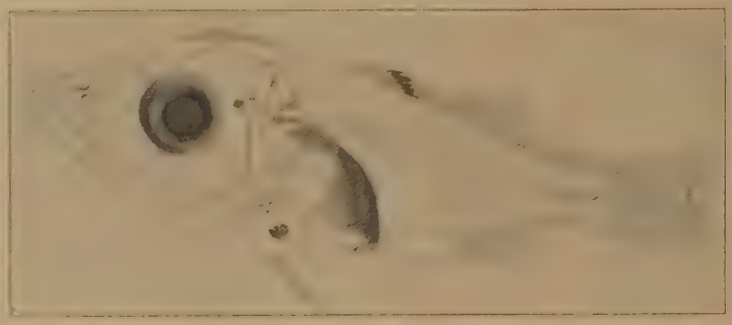

Fig. 5d. Orcynus thynnus L. (?) N. d. Großen Syrte (St. 144) 24. VII. 1910. 7,8 mm lang. Vergr. 14,0 ×.

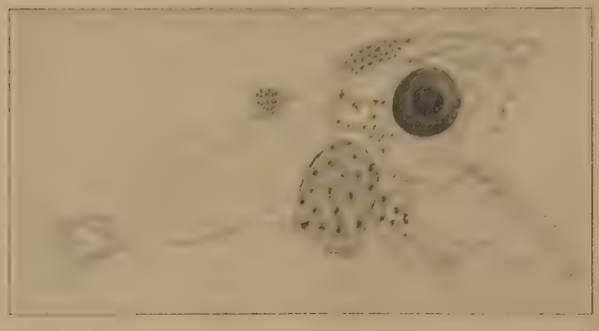

Fig. 5e. Orcynus thynnus L. (?) S. v. Cap Spartivento (St. 189) 19. VIII. 1910. 6,8 mm lang. Vergr. 12,0 ×.

Es ist anzunehmen, daß bei größeren Larven, die mir nicht zu Gesicht gekommen sind, der postanale Raum sich noch weiter verkleinert und damit diese Verhältnisse denen von O. germo ähnlicher werden. (vgl. Fig. 4e und die Anmerkung auf S. 22).

Eine kleine Anzahl ähnlicher und nur wenig jüngerer Larven wurde von »Thor« auf verschiedenen Stationen desselben Gebiets, nämlich des Jonischen Meeres, gefangen, wie aus der am Ende dieses Abschnitts gegebenen Liste ersichtlich ist.

Zunächst sei eine 7,3 mm lange Larve erwähnt, welche am 24. 7. 1910 im südlichen Teil des Jonischen Meeres, nördlich der großen Syrte, bei Station 144 erbeutet wurde und in Fig. 5 d abgebildet ist. Die gedrungene Körperform, der große Kopf, die mit einiger Sicherheit zu 39 feststellbare Wirbelzahl und die weit entwickelte und bereits sehr dunkel pigmentierte 1. D. lassen kaum einen Zweifel aufkommen, daß die Larve hierhergehört. In der 1. D. sind etwa 8 Strahlen erkennbar, in der 2. D. und in der Anale etwa je 13 + VII. Von Kieferzähnen sind jederseits oben und unten etwa 15 vorhanden. Die Präoperkulardornen zeigen die vorbeschriebene Anordnung, die durch die Zahlen 3 + 2 + 2 ausgedrückt werden kann; der mittlere längste ragt eine Strecke weit auf den Eingeweidesack herauf. Die rippenartigen Clavikularfortsätze — die postclaviculae — sind bei diesem Exemplar deutlicher als bei den vorerwähnten. Die Brustflossen reichen nach hinten bis zur Senkrechten des Afters, die Bauchflossen dagegen weniger weit. Die Schwanzflosse ist am Hinterrande erkennbar aber nicht tief eingebuchtet. Der eigentliche Körper der Larve ist fast vollständig frei von Pigment, dagegen ist solches im Peritoneum reichlich und auch am Kopfe an verschiedenen Stellen vorhanden.

Ein noch früheres Entwicklungsstadium ist in Fig. 5 e nach einer 6,8 mm langen Larve festgehalten, die am 19. 8. 10 auf Station 189 südlich von Cap Spartivento durch »Thor« erbeutet wurde.

Auch bei dieser Larve läßt sich mit einiger Mühe die charakteristische Wirbelzahl noch erkennen. Die 2. D. und die A. Flosse befinden sich in einem ziemlich frühen Entwicklungsstadium, dagegen ist die 1. D. mit 8 deutlichen und einigen weiteren undeutlichen Strahlen sowie mit schwarzem Pigment auf den Flossensäumen verhältnismäßig früh und weit entwickelt. Die Schwanzflosse ist am hinteren Rande kaum merklich eingeschnitten. Die Brustflossen sind groß und reichen nach hinten fast bis zur Senkrechten des Afters. Die Bauchflossen sind noch sehr klein und reichen nur bis zur halben Länge des Eingeweidesackes. An Kieferzähnen sind jederseits oben und unten etwa 15 vorhanden, dazu ein Gaumenzahn; von Präoperkulardornen zählt man 3 + 2 + 2. Der Abstand der Afterflosse vom After ist bemerkenswert groß und ist 3,5 mal in der postanalen Körperlänge (ohne C-Flosse) enthalten. Pigment ist außer auf dem Eingeweidesack und am Kopfe nicht vorhanden.

Fig. 5 f. *Orcynus thynnus* L. (?) O. v. Insel Rhodos, 1. VIII. 1910. 4,7 mm lang. Vergr. 16,0 ×.

Die Erwähnung einer noch kleineren Thunfischlarve kann nur mit erheblichem Zweifel bezüglich ihrer Zugehörigkeit zu Orcynus thynnus geschehen. Es befindet sich unter unserem Material eine Larve, welche in der nachfolgenden Liste bei Station 160 aufgeführt ist, und welche nur 4,7 mm lang ist

Verzeichnis der beobachteten Larven von Orcynus thynnus. (?)

Jr. Nr.	Zeit	Ungefähre Ortsangabe	Länge der Leine	Zahl der Larven	Länge in mm	Bemerkungen
144	$^{24}/_{7}$ 10	Südlicher Teil des Jonischen Meeres	25	1	7,3	Fig. 5 d
160	$^{1}/_{8}$ 10	O. der Insel Rhodos	25	1	4,7	Fig. 5 f
161	$^{2}/_{8}$ 10	W. der Insel Rhodos	25	1	7,1	
187	$^{18}/_{8}$ 10	Jonisches Meer O. v. Cap Spartivento	1000	1	9,3	Fig. 5 b und 5 c
189	$^{19}/_{8}$ 10	Südlich von Cap Spartivento	25	1	6,8	Fig. 5 e
192	$^{20}/_{8}$ 10	bei Messina	600	2	6,8; 9,4	Fig. 5 a
196	$^{22}/_{8}$ 10	40 ML S. von Capri	25	1	8,4	
199	$^{28}/_{8}$ 10	O. von Sardinien	300	1	9,2	
215	$^{31}/_{8}$ 10	NW. der Pityusen	25	1	8,0	zwischen zahlreichen Auxis
438	$^{17}/_{11}$ 11	Mitte Atlantik	56	2	6,8; 7,0	
529	$^{5}/_{8}$ 12	NO.-Seite von Malta	57	1	7,8	zwischen 16 Auxis

(Fig. 5f). Sie hat einen großen Kopf, sehr kleinen Eingeweidesack und Präoperculardornen in der Anordnung 2+2+1, Kieferzähne etwa 8 jederseits oben und unten. In den Flossen fehlen die Strahlen noch durchgehends; die 1. D. ist nicht angelegt, der Ansatz der Analen nur sehr schwach angedeutet, und nur die Schwanzflosse ist als hypurale Anlage kenntlich; die Wirbelzahl ist nicht feststellbar. Pigment ist nur im Peritoneum und spärlich auch im Kopf vorhanden.

Die späte Jahreszeit, in die die Mehrzahl der Thorfänge fiel, macht es verständlich, daß sehr jugendliche Thunfischlarven in ihnen fast garnicht vertreten waren.

GATTUNG EUTHYNNUS (Lütken).

Chr. Lütken hat unter dem Gattungsnamen Euthynnus die Thonine (Euthynnus allitteratus Raf.) und den echten Bonito (Euth. pelamis L.) vereinigt, und ich folge ihm hier, obgleich K. Kishinouye neuerdings den Bonito — japanisch Katsuwo — in einer eigenem Familie mit dem Namen Katsuwonidae untergebracht hat, von der er die Gattungen Euthynnus d. s. die Thoninen — zwei japanische Arten und eine atlantische — und Auxis abzweigt. Die häufigere der beiden japanischen Thoninen — von Kishinouye Euthynnus yaito genannt — war von Schlegel früher (1850) mit dem atlantischen Euthynnus allitteratus identifiziert worden.

EUTHYNNUS ALLITTERATUS RAF. (?)

Larven der Thonine habe ich unter dem mir zur Verfügung gestellten Material nur zweifelnd nachweisen können, was vielleicht dadurch zu erklären ist, daß dieser Fisch, über dessen Biologie man außerordentlich wenig weiß, zeitig im Jahre oder im Frühjahr laicht. Es hat aber auch wohl darin seinen Grund, daß diese Larven denjenigen von Auxis, die zahlreich angetroffen wurden, so ähnlich sind, daß die Abtrennung nicht immer gelungen ist. Der Unterschied zwischen beiden Formen im erwachsenen Zustand liegt bei völliger Gleichheit der Wirbelzahl hauptsächlich in der verschiedenen Strahlenzahl der 1. D., die bei Auxis nur 10 bei der Thonine dagegen 15 beträgt. Indessen gelangen gerade die 5 letzten Strahlen, welche die Thonine vor Auxis voraus hat, so spät zur Entwicklung, daß bei jüngeren Larven (bis 10 mm) mit ihrem vollzähligen Vorhandensein nicht bestimmt gerechnet werden kann.

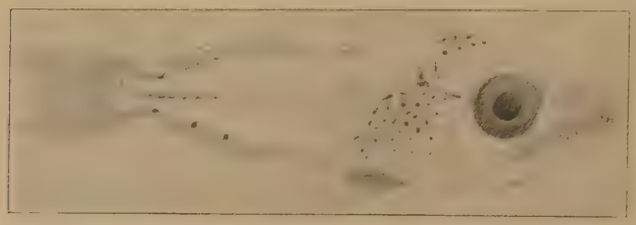

Fig. 6a. Euthynnus allitteratus Raf. (?) N. d. Balearen (St. 208) 29. VIII. 1910. 8,6 mm lang. Vergr. 10,0 ×.

Auf der Station 208 des »Thor«, d. i. östlich der Balearen, wurde am 29. August 1910 eine etwa 8,6 mm lange Scombridenlarve gefangen, welche ich zum Ausgangspunkt für die Charakteristik der Thoninenlarve gemacht habe. Sie ist in Fig. 6a abgebildet.

Sie gleicht in hohem Maße der später zu beschreibenden und durch ein reichhaltiges Material bestimmt charakterisierten Larve von Auxis, mit der sie namentlich die Zahl der Wirbel 20+19 = 39 und den großen Abstand der Afterflosse vom After sowie der 1. D. von der 2. D. gemein hat, und die mit ihr gleichzeitig und im selben Gebiet gefangen wurde. Die Ähnlichkeit der beiden Formen ist in der Tat so groß, daß ich lange Zeit im Zweifel gewesen bin, ob es sich um zwei verschiedene Arten handele, und ob nicht die als E. allitteratus angesprochene auch zu der viel zahlreicher vertretenen Auxis zu rechnen sei, zu der sie jedenfalls in enger verwandschaftlicher Beziehung steht — und in sehr viel näherer als zu Euthynnus pelamis L., dem Bonito — wenn meine Bestimmung richtig ist.

Das wichtigste und ausschlaggebende Unterscheidungsmerkmal für beide Formen besteht in der Ausbildung der 1. D. Zwar ist die Insertion derselben, wie gesagt, in jedem Falle von derjenigen der 2. D. sehr weit entfernt, auch ist die Flosse bei beiden — im Verhältnis zu den Orcynus Arten — klein und

niedrig und erhält ihre ziemlich zarte Pigmentierung erst spät, wenn sie überhaupt zur Ausbildung gelangt, was bei der Thonine mangels größerer Exemplare noch zweifelhaft ist: die Zahl der frühzeitig entwickelten Strahlen der 1. D. beträgt bei beiden Formen etwa 8—9; aber während bei Auxis hinter dem 9. Strahl der Flossensaum meist bis zum Verschwinden niedrig wird und bei Größen von 11—12 mm überhaupt nicht mehr vorhanden ist, behält derselbe bei der Thonine in seinem ganzen Verlauf bis zur 2. D. eine gleichmäßige — wenn auch geringe — Höhe und durch geeignete Färbung scheinen (daher in der Zeichnung fortgelassen) in ihm 6 allerdings sehr undeutliche Strahlen hervorzutreten, die die Gesamtzahl der Strahlen dieser Flosse also auf 15 erhöhen würden, wie das für die ausgebildete Thonine charakteristisch ist. Allerdings darf nicht verschwiegen werden, daß bei einem andern Individuum, das bei St. 206 erbeutet wurde, das mit 10 mm noch erheblich größer war als das ersterwähnte, und das ich ebenfalls als Thonine anzusehen geneigt bin, die letzten 6 Strahlen der 1. D. nicht zu erkennen waren. (vgl. Fig. 6 b).

Fig. 6 b. Euthynnus allitteratus Raf. (?) O. d. Balearen (St. 206) 28. VIII. 1910. 10,1 mm lang. Vergr. 9,0 ×.

Vielleicht handelt es sich um eine ähnliche oder dieselbe Erscheinung, von der M. Sella bei Auxis spricht (l. c. p. 304). Hier sah er bei 12 bis 15 mm langen Larven in dem verbindenden Saume zwischen der 1. D. und 2. D. ca. 6 Strahlen, welche jedoch nicht immer deutlich waren und alsbald in der Furche längs der Mittellinie des Rückens versanken.

Ein zweites Unterscheidungsmerkmal von Auxis glaube ich in der Ausbildung des Pigments auf dem Hinterkörper der Larve erblicken zu sollen. Von der ziemlich reichen Pigmentierung, die den Hinterkörper der Auxislarve auszeichnet, finden sich bei der Thonine nur je ein bis zwei oder drei Pigmentsterne am Anfang und Ende der analen Flößchen und bisweilen noch ein kleiner Stern am Ende der dorsalen Flößchen.

Fig. 6 c. Euthynnus allitteratus Raf. (?) NO. v. Sizilien (St. 194) 21. VIII. 1910. 8,2 mm lang. Vergr. 12,0 ×.

Kaum merkliche und vielleicht ganz unerhebliche Verschiedenheiten finden sich in der Bezahnung und in den Präoperkulardornen.

Bei den 10 und 8,6 mm langen Thoninen zähle ich jederseits $\frac{1}{16}\frac{5}{18}$ Kieferzähne und 1 bis 2 Gaumenzähne; bei einem kleinen Exemplar von 6,4 mm $\frac{1}{13}\frac{3}{8}$ Zähne jederseits.

Von Präoperkulardornen sind jederseits oben und unten 2 kleine vorhanden, und dazwischen stehen im Winkel drei größere, von denen wiederum der mittelste der größte ist. Der oberhalb des großen stehende Dorn zeichnet sich durch besondere Schlankheit in seiner ganzen Länge aus, alles ganz wie bei Auxis. Die Brustflossen sind ziemlich groß und erreichen annähernd die Vertikale des Afters, die Bauchflossen bleiben an Länge etwas dahinter zurück.

Auch die dritte hier im Bilde festgehaltene Larve von 8,2 mm Länge, der St. 194 im NO. von Sizilien vom 21. 8. 1910 entstammend (Fig. 6c), konnte nicht mit größerer Sicherheit identifiziert werden als die erstbeschriebenen. Die Wirbelsumme scheint 39 zu betragen, doch ist die Trennung in Rumpf- und Schwanzwirbel nicht zuverlässig durchführbar. Die Pigmentierung auf dem Hinterkörper ist derjenigen der Figuren 6a und 6b sehr ähnlich; auch hier sind nur je 2 stark kontrahierte Pigmentpunkte an der ventralen und der dorsalen Körperkontur vorhanden. Ein auffallender Unterschied besteht jedoch in der Ausbildung der 1. D., die zwischen den bereits entwickelten 7—8 Strahlen zierliches Pigment besitzt, etwa in

derselben Weise wie die Thunfischlarven. Dennoch erscheint der Körper der Larve für einen Orcynus zu sehr gestreckt. Der Analabstand ist sehr groß, der After liegt bei Abrechnung der Schwanzflosse ungefähr gerade in der Mitte des Körpers; die Präoperkulardornen mit 2 + 3 + 1 Spitzen könnten ebensogut einem Euthynnus wie einem Orcynus angehören.

Die Brustflossen sind wie gewöhnlich groß und reichen bis zur Senkrechten des Afters nach hinten; die Bauchflossen sind noch klein und wenig entwickelt.

Außer den im Balearischen Meer und nördlich von Sizilien gefangenen Larven sind in nachfolgender Liste noch 11 Stück von 5 bis 9 mm Länge aufgeführt, die am 27. 8. 11 bei St. 341, SO. von Kreta, gefangen wurden. Diese sind ausnahmslos so mangelhaft erhalten, daß es schon deshalb schwierig ist, sie zu identifizieren. Indessen läßt sich doch feststellen, daß eine ähnliche Pigmentverteilung auf dem Hinterkörper vorhanden ist, wie bei den in Fig. 6a bis 6c abgebildeten Larven, nämlich meistens 2 bis 4 dichte Pigmentpunkte längs der analen Körperkontur, bisweilen auch 1 bis 2 Punkte an der dorsalen Kontur. Die 1. D. ist auch bei den größeren Exemplaren ganz ohne Pigment.

Es braucht nicht verhehlt zu werden, daß alle hier als Thoninen aufgeführten Larven nicht zuverlässig identifiziert und in Wirklichkeit vielleicht nur etwas abweichend pigmentierte Auxis Larven sind, zumal es an Zwischenformen auch nicht fehlt. Möglicherweise kann auch nur die in fig. 6c abgebildete auf St. 194 erbeutete Larve als richtig bestimmt angesehen werden.

Verzeichnis der beobachteten Larven von Euthynnus allitteratus (?).

Jr. Nr.	Zeit	Ungefähre Ortsangabe	Länge der Leine	Zahl der Larven	Länge in mm	Bemerkungen
194	$^{21}/_{8}$ 10	NO. von Sizilien	25 m	1	8,2	Fig. 6 c
205	$^{27}/_{8}$ 10	Mitte des Balearischen Meeres	25 -	1	7,6	
206	$^{28}/_{8}$ 10	O. d. Balearen	25 -	1	10,1	Fig. 6 b
208	$^{29}/_{8}$ 10	N. d. Balearen	25 -	2	6,4 8,6	Fig. 6 a
341	$^{27}/_{8}$ 11	SO. von Kreta	108 -	11	5,9	schlecht erhalten

EUTHYNNUS PELAMIS L. (?)

Vom Bonito (Euthynnus pelamis L.) glaube ich im folgenden eine etwas vollständigere Reihe der Entwicklungsformen vorführen zu können.

Der echte Bonito, der zum Unterschied von dem längs des Rückens gestreiften Pelamiden (Pelamis sarda C. V.) auch der bauchstreifige genannt wird, ist eine tropische Form und soll eine kosmopolitische Verbreitung besitzen, was indessen nicht vollkommen sicher ist; auch in den Meeren der gemäßigten Zonen kommt er vor und geht z. B. um das Kap der guten Hoffnung herum; aber im Mittelmeer ist er offenbar spärlich vertreten und scheint auf den westlichen Teil der nordafrikanischen Küste beschränkt zu sein; nach den nördlichen Meeren hat er sich nur sehr selten verirrt.

Den Seefahrern ist er eine wohlbekannte Erscheinung, da er oft scharenweis das Schiff begleitet und von diesem aus bei seinen Jagden auf die fliegenden Fische beobachtet werden kann. Im allgemeinen wird er im offenen Meere häufiger angetroffen und gefangen als in Küstennähe. Das bekannteste Fanggebiet für den Bonito im Bereich des Atlantik ist aber die westmarokkanische Küste von El Araisch südwärts, woselbst zahlreiche spanische Fischer mit etwa 300 Fahrzeugen von der Küste der Mittelmeer-Provinz Murcia ihm im Monat Mai mit Treibnetzen und Schleppangeln nachstellen, während er neuerdings auch später — im Juni bis September — als abgelaichter Fisch erfolgreich bei Fedala unweit Casablanca in einer madrague gefangen werden konnte. Nach Meinung der Kanarischen Fischer hat der ersterwähnte Betrieb mit Treibnetzen einen nordwärts zum Laichen ziehenden Fisch zum Gegenstand (poisson de course), der spätere mit der madrague einen nach dem Laichen südwärts gehenden (poisson de retour).

Auch KISHINOUYE bezeichnet als Laichzeit die Monate Mai bis August. Die reifen planktonischen Eier sind nicht bekannt.

Als Flossenformel gilt im Allgemeinen D: 12 bis 17 + 11 bis 14 + VIII A: 11 bis 15 + VII, meist aber D: 15 + 1/12 + VIII, A: 2/12 + VIII. Die Wirbelzahl beträgt nach KISHINOUYE Vert: 20 + 21, übereinstimmend mit einer Angabe von STARKS, die sich allerdings auch auf ein japanisches Exemplar bezieht.

Nach diesen etwas spärlichen Anhaltspunkten habe ich geglaubt, eine Anzahl von Thynnidenlarven, welche zumeist im offenen Atlantik erbeutet wurden, als zum Bonito gehörig ansehen zu sollen. Den Ausgangspunkt für diese Zuweisung bildet eine 10 mm lange Larve — die größte der in Betracht kommenden — welche am 13. 7. 1912 vom Dampfer »St. Croix« auf St. 532 in der Mitte des Atlantik (bei 29° 12′ N. und 36° 7′ W.) gefangen wurde, und welche in Fig. 7a abgebildet ist.

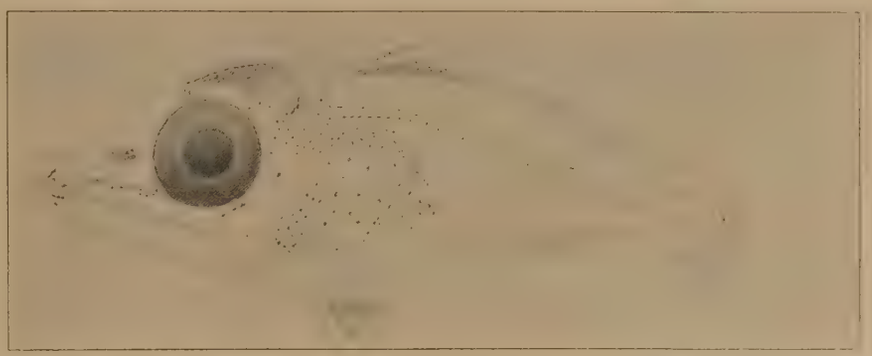

Fig. 7a. Euthynnus pelamis L. (?) Mitte Atlantik (St. 532) 13. VII. 1912. 10,0 mm lang. Vergr. 12,0 ×.

Die Zahl der Rumpfwirbel konnte nicht einwandfrei ausgemacht werden, die Zahl der Schwanzwirbel aber mit genügender Sicherheit zu 21 bestimmt werden, und hierin habe ich einen — wenn auch nicht sicheren so doch — beachtlichen Hinweis auf die Zugehörigkeit dieser im Übrigen mit genügender Deutlichkeit als Thynnide charakterisierten Larve erblickt.

Der Kopf ist außerordentlich groß, der After liegt um 9% der Totallänge (ungerechnet die Schwanzflosse) hinter der Körpermitte, die Insertion der Afterflosse um 18% der Schwanzlänge hinter dem After. Die Augen sind ebenfalls groß und erreichen an Durchmesser die Länge der Schnauze (vor den Augen). Die Zahl der Kieferzähne beträgt jederseits oben und unten etwa 12 bis 15; dieselben sind vielfach noch im Entstehen begriffen, spitzig aber nicht sehr kräftig — schwächer als bei den Orcynus-Arten. — Im Gaumen sind jederseits 3—4 größere und daneben kleinere im Entstehen begriffene Zähne sichtbar. Die Narinen sind bereits voneinander getrennt.

Fig. 7b. Euthynnus pelamis L. (?) Präoperculum. Mitte Atlantik (St. 533) 15. VII. 1912. Vergr. 30,0 ×.

Die Brustflossen reichen nicht bis zum After nach hinten, auch die Bauchflossen sind kurz und verhältnismäßig weit zurück in der Entwicklung. Die unpaaren Flossen sind in normaler Weise entwickelt, obwohl die Gesamtzahl der Strahlen (einschließlich der Flößchen) in der 2. D. mit 23 und in der Anale mit 21 etwas hoch erscheint. Die 1. D. zeigt charakteristische Besonderheiten. Ihre Strahlen sind lang und erreichen den Anfang der 2. D., aber sie sind dünn und zerbrechlich und auf den Flossensäumen ist reichliches und bisweilen — wenn auch nicht immer — sehr dunkles Pigment vorhanden. Die Zahl der erkennbaren Flossenstrahlen beträgt 10.

Die Präoperkulardornen (Fig. 7b) sind sehr zart und schwach entwickelt; nur an der Ecke sind 2 lange sehr schmale Dornen auffällig, von denen der untere bis weit auf den Eingeweidesack hinaufreicht; davor stehen am horizontalen Ast 3 nach dem Kiefer zu an Größe abnehmende und an dem vertikalen Ast 2 noch schwächer entwickelte kleine Dornen.

Trotz der geringen Körpergröße des Fischchens ist auf dem ursprünglich pigmentlosen Rumpf schon

ziemlich viel Pigment entwickelt und zwar hauptsächlich oberhalb und seitlich längs der Wirbelsäule; außerdem ist in Kopf und Eingeweidesack reichlich Pigment vorhanden und kleinere Pigmentansammlungen in den vordersten Spitzen beider Kiefer; bemerkenswert sind eine oder zwei winzige Chromatophoren an der Basis der oberen Hälfte der Schwanzflosse, die auch bei anderen Scombridenlarven in ähnlicher Form vorkommen.

Eine Anzahl kleinerer Larven, deren Zugehörigkeit zu dem erstbeschriebenen größeren Exemplar von 10 mm zum mindestens sehr wahrscheinlich ist, und welche in der Zusammenstellung am Ende dieses Abschnittes aufgeführt sind, wurden sämtlich im offenen Atlantik zwischen der afrikanischen und der amerikanischen Küste, und zwar zwischen 33° N. Br. und 1° S. Br. gefangen.

Von diesen kleineren Larven verdienen zunächst einige von etwa 8 mm Länge erwähnt zu werden (Fig, 7c). Bei mehreren von ihnen ist die Zahl der Schwanzwirbel zu 21 feststellbar und in vereinzelten Fällen auch die Zahl der Rumpfwirbel mit 20 wahrscheinlich. Das vorerwähnte Körperpigment fehlt noch; nur im Kopf und Peritoneum sowie in der Kieferspitze ist Pigment vorhanden und ebenso in der 1. D., wo es meist auf den distalen Teil beschränkt ist aber bisweilen schon tiefschwarz erscheint. Die Strahlen dieser Flossen sind ebenso zart aber kürzer als bei dem 10 mm langen Exemplar, so daß sie den Anfang der 2. D. meist nicht erreichen. Die Brustflossen erscheinen verhältnismäßig größer als später und schneiden nach hinten senkrecht über dem After ab, dagegen sind die Bauchflossen auffallend kurz und unentwickelt. Die Schwanzflosse ist wohl ausgebildet und bereits eingeschnitten.

Fig. 7c. Euthynnus pelamis L. (?) S. d. Capverden (St. 525) 30. VII. 1912. 8,0 mm lang. Vergr. 10,0 ×.

Die Zähne sind schwächlich und jederseits oben und unten zu 12—15 vorhanden, Gaumenzähne nur ganz vereinzelt.

Der Eingeweidesack ist gedrungen, von triedrischer Form, mit großer Schwimmblase und erheblichem Pigment ausgestattet. Bei den meisten Exemplaren ist es durch Aufreißen der Bauchwand zu einem Vorfall des Enddarms gekommen.

Die Präoperkulardornen sind etwas deutlicher als bei dem größeren Exemplar, aber nach dem gleichen Schema ausgebildet (Fig. 7b): Am horizontalen Ast 3 nach hinten an Größe zunehmende Dornen, dann an der Ecke 2 lange sehr schlanke, deren unterer längster bis weit auf den Eingeweidesack herauf und selbst bis zum Enddarm nach hinten reicht; ihnen folgen am vertikalen Ast noch 2 wenig deutliche kleine Spitzen.

Eine Anzahl Larven von 6 und 7 mm Länge lassen in ihrem Bau den Übergang in die eben beschriebene Form erkennen. Körperpigment ist in entsprechender Weise ausgebildet; bisweilen ist die schon erwähnte vereinzelte kleine Chromatophore an der Basis der oberen Hälfte der Schwanzflosse sichtbar. Die 1. D. besitzt bereits Pigment, und zwar erscheint dasselbe etwa bei 6 mm Gesamtkörperlänge; es entsteht in Form kleiner ovaler Flecke, welche zu je einem auf der Mitte der Flossenhaut zwischen zwei Strahlen liegen. Die Höhe der Flosse ist noch gering, und es sind zunächst nur etwa 6 Strahlen in ihr erkennbar, doch ist die erste Spur des Erscheinens der 1. D. schon bei wenig über 5 mm langen Larven erkennbar, sodaß also auch hier, wie bei den Orcynus Arten, die 1. D. auffallend früh auftritt.

Die Schwanzflosse ist bei 6 mm und weniger, ja selbst bei 5 mm Länge schon endständig geworden, aber nocht nicht eingeschnitten. Die andern unpaaren Flossen sind in der Entwicklung noch sehr zurück und lassen die definitive Strahlenzahl nicht erkennen. Die Bauchflossen sind noch ganz klein und wenig entwickelt.

Der Abstand der Analflosse vom After macht etwa $^1/_5$ der Schwanzlänge aus (ungerechnet die Schwanzflosse). Die Präoperkularbewaffnung zeigt schon dieselbe Anordnung wie bei den älteren Larven; die beiden schlanken mittleren Dornen, namentlich der untere und längste von beiden, ragen nach hinten

weit auf den Eingeweidesack hinauf, wie denn überhaupt der Kiemendeckel einen großen Teil des Eingeweidesackes bedeckt, sodaß der letztere sehr zusammengedrückt und klein erscheint.

Die Larven von etwa 5 mm Länge lassen die 1. D. nur als schmalen Saum ohne Strahlen erkennen, ihre Präoperkularbewaffnung ist aber schon in charakteristischer Form ausgebildet. Selbst bei noch kleineren Larven — von 4,4 mm Totallänge — bei welchen das Urostyl noch horizontal gestreckt ist und unter demselben nur die früheste Anlage der hypuralen Schwanzflosse erkennbar ist, ist an der Stelle der späteren 1. D. bereits ein schmaler Flossensaum vorhanden.

Verzeichnis der beobachteten Larven von Euthynnus pelamis L.

J. Nr.	Datum	Ungefähre Ortsangabe	Länge der Leine	Zahl der Larven	Größe der Larven	Bemerkungen
342	$^{7}/_{8}$ 11	Mitte Atlantik	40 m	3	7,0; 6,6; 5,2	
343	$^{10}/_{8}$ 11	Sargasso Meer	48 -	2	7,9; 6,3	?
344	$^{6}/_{9}$ 11	Mitte Atlantik	48 -	4		
344	$^{6}/_{9}$ 11	Mitte Atlantik	40 -	2	7,9; 6,6	
349	$^{6}/_{9}$ 11	Sargasso Meer	35 -	2	5,0; 4,4	
394	$^{10}/_{11}$ 11	N. v. Barbados	48 -	2	6,6; 6,0	
525	$^{30}/_{7}$ 12	S. der Capverden	133 -	5	7,3; 7,3 7,5; 8,1	Fig. 7 c
532	$^{12}/_{7}$ 12	Mitte Atlantik	66 -	2	10,0; 7,3	Fig. 7 a
533	$^{15}/_{7}$ 12	Mitte Atlantik	57 -	2	8,2; 6,5	z. T. schlecht erhalten. Fig. 7 b
534	$^{18}/_{7}$ 12	NO. der Antillen	57 -	3	8,0; 6,3; 6,0	z. T. schlecht erhalten.
543	$^{6}/_{8}$ 12	Sargasso Meer	17 -	6	4,4 6,3	
555	$^{3}/_{10}$ 12	Sargasso Meer	94 -	1	6	
564	$^{15}/_{9}$ 12	S. der Capverden	47 -	7	5,2—7,1	wohl nicht alle hierher gehörig Z. T. schlecht erhalten.
610	$^{20}/_{9}$ 12	W. der Capverden	28 -	1	5,7	
670	$^{17}/_{12}$ 12	SW. d. Lakkadiven	113 -	6	5,5—4,0	?

AUXIS THAZARD LACÉP.

Dieser unter zahlreichen Synonymen beschriebene Fisch besitzt eine so große Verbreitung, daß er als kosmopolitisch bezeichnet werden kann, vorausgesetzt, daß die im Pazifik, im Atlantik sowie im Mittelmeer vorkommenden Formen alle derselben Art zugerechnet werden können, woran einstweilen kaum zu zweifeln ist.

Der Gattungsnahme Auxis stammt von Valenciennes; nach Aristoteles bezeichneten die Byzantiner mit diesem Namen sehr junge Thunfische; der Artname thazard stammt von Lacépède, dem ersten Beschreiber dieser Form. Das Wort ist von dem französischen tassard abgeleitet, womit die Arten der Gattung Scomberomorus bezeichnet werden (englisch seerfishes). Angaben über die außerordentlich zahlreichen Vulgärnamen finden sich bei Carus; im deutschen ist der Fisch als Fregattenmakrele bezeichnet worden, englisch frigate mackerel oder plain bonito.

Durch den großen Abstand seiner Rückenflossen, sowie durch sein Corselet, seinen Schwanzkiel und seine zahlreichen Flößchen stellt Auxis ein Verbindungsglied dar zwischen Makrelen und Thunfischen. Die Körperform ist die einer Thonine, aber ein wenig schlanker, die Körperhöhe ist viermal und darüber in der Länge enthalten, bei den jungen Individuen sechsmal; der Kopf ist viermal und bei den kleinen $4^{1}/_{4}$ oder $4^{1}/_{3}$ mal in der Totallänge enthalten. Die Kiefer sind ziemlich gleich lang; die Zähne mit bloßem Auge kaum sichtbar, auf Gaumen and Vomer fehlend. Der Rand des Präoperkulum hat die Form einer Halbellipse wie bei den Thoninen.

Eine Schwimmblase fehlt, aber das sehr dicke faserige sich längs der Wirbelsäule erstreckende Peritoneum täuscht eine zusammengesunkene Schwimmblase vor.

Die Flossenformel lautet 1. D.: 10—11, 2. D.: 12 + VII, A: 12 + VII, P.: 21—22, V.: 1 + 6, C.: x + 17 + x = 32, Der 11. Strahl der 1. Dorsale wird nur durch Zerlegen des Fisches sichtbar; die 2. Dorsale ist sehr kurz; unter ihrem Ende beginnt die Anale.

Die Wirbelsäule besteht aus 20 + 19 = 39 Wirbeln wie bei der Thonine.

Die 1. D. reicht vom 6. bis zum 11., ihr 1. Stützstrahl aber liegt zwischen dem 2. und 3. Wirbel; die 2. D. beginnt auf dem 20. Wirbel.

Die mittlere Größe des Fisches beträgt 30 bis 45 cm, doch wird er bis zu 6 Pfund schwer. Das Fleich ist dunkelrot und wird an der Luft schwarz; es ist schwer verdaulich und hat einen scharfen Geschmack, daher wird der Fisch fast überall gering geachtet.

Fig. 8a. Auxis thazard Lacép. NW. d. Pityusen (St. 215) 31. VIII. 1910. 12,0 mm lang. Vergr. 10,0 ×.

Er wird in den Tonnaren des Mittelmeeres oft zu vielen Tausenden gefangen. Neuerdings ist er auch in sehr großen Schwärmen (ähnlich wie Pelamis sarda Bl.) an der Ostküste von Nordamerika beobachtet und gefangen worden, wo er als unwillkommener Gast angesehen wird, da es sich nach Brown Goode kaum lohnt, ihn als Dünger zu verwenden.

Die Laichzeit von Auxis fällt nach übereinstimmenden Angaben hauptsächlich in den Monat August; und diese auffallend späte Lage der Laichzeit ist wohl zumeist dafür verantwortlich zu machen, daß Auxis die am zahlreichsten und lückenlosesten vertretene Art unseres Materials darstellt, doch fand L. Sanzo auch im Juni und Juli reife Ovarien. Die planktonischen Eier sind wasserhell 1,10 mm groß, mit homogenem Dotter und einer großen Ölkugel, die aus mehreren zu verschmelzen scheint. Die Angabe von Valenciennes, daß die Eier in einen rötlichen Schleim eingehüllt seien, findet sich später nicht bestätigt.

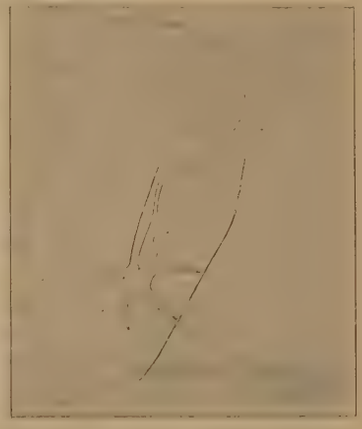

Fig. 8b. Auxis thazard Lacép. NW. d. Pityusen (St. 215) 31. VIII. 1910. 12,0 mm lang. Präoperculum. Vergr. 18,0 ×.

L. Sanzo, der die künstliche Befruchtung ausführte, gibt die Inkubationsdauer zu $2^1/_2$ Tagen an. Die ausschlüpfende Larve ist nur 3 mm lang und sehr durchsichtig. Der Kopf ist klein und abgerundet und mißt $^1/_9$ (?) der Körperlänge, der Dottersack ist groß und rundlich und enthält hinten den Öltropfen, der in eine Hülle von zahlreichen bei auffallendem Licht lebhaft gelb glänzenden Pigmentzellen eingebettet ist. Längs des Rumpfes sieht man 6 große dunkle und verzweigte Pigmentsterne. Der After liegt fast unmittelbar hinter dem Dottersack, der postanale Körperteil ist verhältnismäßig lang.

»Thor« hat im Mittelmeer eine große Zahl von Auxislarven erbeutet, die meisten im August, wenige noch bis in den September hinein und in Größen von 5—12, frisch 13,5 mm. Allerdings war es nicht möglich, den Übergang der von Sanzo beschriebenen jüngsten Entwicklungsformen in die kleinsten in Freiheit gefangenen Larvenstadien zu verfolgen, zumal nach M. Sella die Pigmentverteilung bei diesem Übergang eine sehr weitgehende Veränderung erleidet; aber die größten Larven erlaubten sowohl die Strahlenzahl in sämtlichen Flossen wie namentlich auch die Wirbelzahl festzustellen, und danach konnte die Zugehörigkeit dieser Larven zu Auxis nicht zweifelhaft sein. Die Wirbelzahl von 20 + 19 — bei Valenciennes heißt es: »l'anale s'attache sous la 21^e vertèbre« — ließ zunächst noch die Möglichkeit offen, daß es sich um

Larven von Euthynnus allitteratus Rafin., der Thonine, handele. Indessen ist die Strahlenzahl der 1. Rückenflosse bei der letzteren mit 15 so erheblich größer als bei Auxis (9—10), daß selbst bei Annahme einer noch nicht voll entwickelten Flosse immer noch der Ausschlag zu Gunsten von Auxis gegeben werden konnte.

Die Hauptmenge der hierher gehörigen Larven und die vollkommenste Entwicklungsreihe wurde auf den Stationen 213 und 215 am 31. August 1910 gefangen, letztere NW. von den Pityusen, erstere im gleichen Meeresteil SO. der Ebro-Mündung gelegen.

Die größten Exemplare unseres Materials (Fig. 8a) lassen bei zweckmäßiger Färbung mit vollkommener Sicherheit nicht nur — wie auch schon jüngere Exemplare — die Wirbelzahl von 20 + 19 erkennen, sondern auch die definitive Zahl von 10 Flossenstrahlen in der 1. D. Zierliche Pigmentpunkte liegen auf der Mitte dieser Flosse. Der 1. Strahl der Flosse steht über dem 5. Wirbel, doch lehnt sich sein Stützstrahl hinter dem 2. Wirbel auf den Dornfortsatz des 3. Wirbels; der erste Stützstrahl von der in weitem Abstand und ohne verbindenden Flossensaum folgenden 2. D. liegt zwischen den Dornfortsätzen des 18. und 19. Wirbels.

Die Afterflosse hat trotz der vorgeschrittenen Entwicklung der Larve großen Abstand vom After, und derselbe würde noch größer sein, wenn nicht der Enddarm in diesem Stadium begonnen hätte, sich mit ziemlich scharf ausgezogener Spitze nach hinten auszubreiten und damit den After weiter rückwärts zu verlegen.

Da die Flößchen sowohl dorsal wie anal in ihrer definitiven Zahl bestimmbar sind, so erkennt man die Strahlen in der 2. D. und in der Afterflosse zu 2. D.: 12 + VIII, A.: 12 + VII.

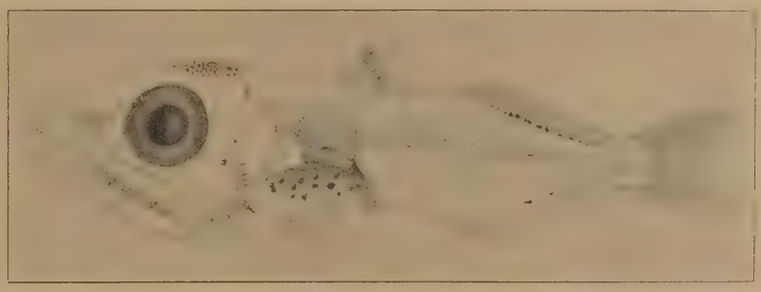

Fig. 8c. Auxis thazard Lacép. O. d. Balearen (St. 206) 28. VIII. 1910. 11,6 mm lang. Vergr. 9,0 ×.

Die Brustflossen bedecken zwar einen großen Teil des Eingeweidesacks, jedoch nicht viel mehr als die Hälfte seiner Länge, die Bauchflossen (V: 1 + 6) reichen nur ganz unerheblich weiter nach hinten.

Die ungemein kräftige und dichte Bezahnung der Kiefer weist jederseits oben und unten etwa 18 bis 20 Zähne auf, und dazu treten 2 bis 3 Gaumenzähne jederseits. Der Schlund ist dicht besetzt mit Zähnen, von denen auf der Unterseite etwa 12 Stück große und spitzige stehen, oben dagegen viel weniger.

Die Narinen sind bereits vollständig voneinander getrennt; die vordere ist von einer zierlich ausgebildeten Rosette umgeben.

Die Bewaffnung des Kopfes und insonderheit des Präoperculum ist aus der Fig. 8a und noch besser aus der Umrißzeichnung der Fig. 8b erkennbar. Am Winkel des Präoperculum stehen 3 größere Dornen, von denen der untere der kleinste ist, und der obere in gerader Fortsetzung des horizontalen Präoperkular-Astes liegt; ihnen folgen nach vorn und nach oben je zwei kleinere, von denen die vorderen etwas breiter und stumpfer sind. Die Länge der Dornenfortsätze des Präoperkulum ist auf dieser Entwicklungsstufe schon soweit reduziert, daß nur noch der mittelste und längste ein wenig auf den Eingeweidesack heraufreicht. An dem oberen Ausläufer des bedornten Präoperkularrandes ist ein kleiner nach hinten gerichteter Dorn — auf dem Hyomandibulare — ausgebildet; in der Temporalgegend über der Otocyste am Ansatz des Schultergürtels ein ähnlicher größerer. Bemerkenswert ist auch der in diesem und auch schon in früheren Entwicklungsstadien meist deutliche stabförmige Fortsatz (Postclavicular-Styloid), der von dem oberen Teil des Schultergürtels — der supraclavicula nach Parker — abzweigt und schräg nach unten und hinten über den Eingeweidesack verläuft, indem er diesen wie ein Reifen oder ein Rippenpaar stützt. (vgl. Fig. 8a und 8c).

Die Verteilung des Pigments läßt zwar in der Regel einen bestimmten Plan erkennen, doch ist es

nicht immer gleichmäßig kräftig ausgebildet. Längs der dorsalen und analen Kontur des postanalen Körperabschnitts zieht sich eine fast ununterbrochene Reihe von Chromatophoren hin, die anal oft sehr matt erscheint, dorsal dagegen wesentlich stärker, dichter und etwa bis zur Mitte oder zum Anfang der 2. D.-Flosse nach vorn reichend. Neben sowie über und unter der Wirbelsäule sind Pigmentreihen in wechselnder Stärke und Länge ausgebildet, letztere bisweilen bis zum Kopfe reichend. Im Peritoneum, namentlich im Bereich der Schwimmblase sowie auf dem Gehirn ist reichlich Pigment vorhanden.

Die nur wenig kleinere Larve der Figur 8c zeigt ein sehr ähnliches Bild und kann als Repräsentant der Größen von 10 bis 12 mm gelten.

Fig. 8d. Auxis thazard Lacép. NW. d. Pityusen (St. 215) 31. VIII. 1910. 8,0 mm lang. Vergr. 12,0 ×.

In der 1. D. zählt man bereits 8 bis 9 Strahlen und zwischen diesen häufig — wenn auch nicht immer — zarte schwarze Pigmentpunkte. Das unregelmäßige Erscheinen der letzteren erklärt sich vielleicht dadurch, daß sie zum Teil im distalen Abschnitt der Flossensäume liegen, und daß dieser häufig ausgerissen und zerfasert ist. Die Strahlen der 2. D. und der A.-Flosse sind bereits gut entwickelt, aber der postanale Raum ist noch größer als in der Fig. 8a, da der After noch nicht soweit nach hinten gerückt ist wie dort. Dementsprechend erscheinen Brust- und Bauchflossen etwas länger, da ihre Hinterränder dem After näher liegen als bei Fig. 8a. Bezahnung und Präoperkularbewaffnung sind von dem Stadium der Fig. 8a nicht wesentlich verschieden.

Auch das Pigment ist ähnlich ausgebildet, wenn auch deutlich schwächer. An der Basis der 2. D. liegen die Chromatophoren ziemlich dicht und erreichen fast den vorderen Ansatz dieser Flosse; an der Basis der Afterflosse sind sie sehr viel spärlicher gesät. Von den längs der Wirbelsäule verlaufenden Pigmentreihen sind nur die seitlich der Wirbelsäule im caudalen Abschnitt liegenden entwickelt. Auch das Pigment im Peritoneum und am Kopf ist wesentlich schwächer entwickelt als bei dem Stadium der Fig. 8a.

Bei Larven von 9—10 mm Länge ist die 1. D. schon wohl entwickelt und läßt etwa 8 Strahlen erkennen, zwischen denen auf dem distalen Teil der Verbindungshäute bisweilen schon einige dunkle Pigmentpunkte erkennbar sind, wennschon sie meist noch fehlen. Zwischen den beiden Rückenflossen ist ein langer strahlenloser Verbindungsraum sichtbar. Die Strahlen der 2. D. und der Afterflosse sind bereits gut entwickelt. Über den 18—20 Zähnen, welche oben und unten jederseits in den Kiefern stehen, sind meist 2 Gaumenzähne erkennbar, bisweilen auch noch ein sehr kleiner dritter.

Fig. 8e. Auxis thazard Lacép. O. d. Balearen (St. 206) 28. VIII. 1910. 7,5 mm lang. Vergr. 11,0 ×.

Von Körperpigment sind bisweilen schon die jederseits neben und über der Wirbelsäule verlaufenden Reihen von 3 bis 6 Sternen vorhanden, regelmäßiger aber die in charakteristischer Weise geordneten Chromatophoren an der Basis der 2. D., der Schwanzflosse und der Anale. Bemerkenswert ist jedoch, daß alle diese Pigmentreihen bisweilen sehr schwach entwickelt sind und nur wenig über die Region der Flößchen hinaus nach vorn reichen.

Larven von 7,5 bis 8 mm Körperlänge (Fig. 8d und e) besitzen bereits die 1. D., wenn auch noch ohne Pigment und mit nur wenigen (4—5) kleinen und niedrigen Strahlen. Ihr Abstand von der Insertion der 2. D. ist groß und beträgt etwa 1,6 bis 1,7 mm. Die Bauchflossen sind schon gut entwickelt, die Brustflossen reichen bis über den After nach hinten. Der After liegt schon etwa in der Mitte des Körpers — ungerechnet die Schwanzflosse — da der Eingeweidesack im Begriff ist, die im jüngeren Stadium stark komprimierte und fast gleichschenkelige Form zu Gunsten einer gestreckten Gestalt aufzugeben.

Bei Larven von 7 mm Länge ist die Schwanzflosse schon endständig geworden; die Stützstrahlen der 2. D. und A.-Flossen sind soweit deutlich, daß der außerordentlich große Abstand der Insertion der letzteren vom After erkennbar und zu etwa 1,1 mm Länge feststellbar ist. Der Kopf erscheint verhältnismäßig groß; Kieferzähne sind etwa 10 bis 12 jederseits oben und unten vorhanden; die Spitze des Oberkiefers ragt mit den vordersten ziemlich großen Zähnen schon über den Unterkiefer hinaus.

Die Larve von 5,7 mm Länge (Fig. 8f) läßt außer der noch deutlich heterocerk gestalteten Schwanzflosse von den Anlagen der unpaaren Flossen noch nichts erkennen. Die verhältnismäßig großen Brustflossen reichen über den ganzen stark komprimierten Eingeweidesack nach hinten; von den Bauchflossen sind nur die frühesten Knospen erkennbar. Auf den Kiefern stehen schon 9—10 feine spitzige Zähne jederseits oben und unten; die Präoperkulardornen — etwa 7 jederseits — treten deutlich hervor und reichen auf den Eingeweidesack hinauf. Das Pigment des Hinterkörpers ist in charakteristischer Form ausgeprägt; oben etwa 3, unten etwa 6 Pigmentpunkte längs der Körperkontur.

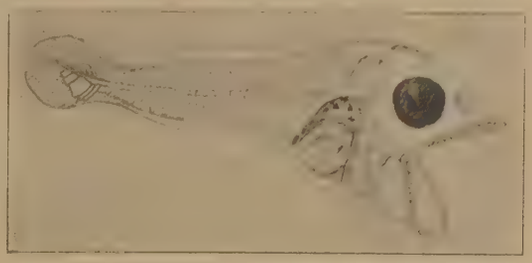

Fig. 8f. Auxis thazard Lacép. NW. d. Pityusen (St. 215). 31. VIII. 1910. 5,7 mm lang. Vergr. 12,0 ×.

Die kleinsten 5 mm langen Larven (Fig. 8g) haben einen großen und hohen Kopf mit weitem reich bezahntem Rachen; der Unterkiefer reicht nach hinten bis zur Senkrechten vom hinteren Augenrand. Die Zahl der Zähne beträgt in diesem Stadium etwa 7—8 jederseits oben und unten, erfährt aber bald eine Vermehrung; im Gaumen sind noch keine Zähne sichtbar, wohl aber im Schlund, in welchem oben und unten je 6—7 kräftige Zähne stehen.

Der Präoperkularrand besitzt eine stark entwickelte Bedornung, deren wesentlicher Charakter schon in diesem Stadium festgelegt ist; auf eine vordere dreispitzige Leiste (crista) folgt der eigentliche fast rechtwinklig gebogene Rand mit 3 + 1 + 1 Dornen, die vom Scheitel des Winkels aus nach den beiden Schenkelenden hin ziemlich gleichmäßig an Größe abnehmen, später jedoch 3 Gruppen erkennen lassen, eine obere und eine vordere mit je zwei kleinen Dornen und eine mittlere mit 3 größeren, von denen wiederum der mittlere der längste ist. Dieser letztere ragt nach hinten weit über den Schultergürtel hinaus und bis fast an den hinteren Rand des Eingeweidesacks heran.

Fig. 8g. Auxis thazard Lacép. NW. d. Pityusen (St. 213) 31. VIII. 1910. 5,0 mm lang. Vergr. 16,0 ×.

Der Eingeweidesack hat die Form eines gleichschenkeligen Dreiecks, an dessen Spitze eine stark gewölbte und hinten nach dem After zu spitz auslaufende Schwimmblase in einer dichten Pigmenthülle erkennbar ist. Der Abstand des Afters von der Schnauzenspitze beträgt etwa $^2/_5$ der Totallänge.

In den Flossensäumen sind Strahlen noch nicht erkennbar, doch sind die ersten Spuren der Stützstrahlen der Anale und der 2. Dorsale bereits vorhanden; das Urostyl ist leicht aufgebogen und läßt auf seiner Unterseite die heterocerke Anlage der Schwanzflosse erkennen. Die Bauchflossen sind als Knospen sichtbar, dahinter auch ein noch längere Zeit persistierender Rest eines präanalen Flossensaumes. Die Brustflossen sind sehr groß und reichen bis zum After oder etwas darüber hinaus nach hinten.

Dunkles Pigment ist außer an der Schwimmblase auf der Oberseite und Unterseite des Groß- und Kleinhirns vorhanden, und ferner in spärlicher Verteilung auf der hinteren Hälfte des postanalen Körperabschnitts, sodaß ohne feste Regel in der dorsalen Körperkontur 2 bis 3, in der analen 6—7 Chromatophoren sichtbar sind.

In unregelmäßiger Ausbildung sind auch in der Basis der Schwanzflosse 1 bis 2 Chromatophoren erkennbar.

Die hier gegebene Charakteristik der Auxislarven stimmt mit derjenigen von M. Sella in ziemlich befriedigender Weise überein. Daher ist auch an der Richtigkeit der Angaben von Sella über die Pigmentierung der noch jüngeren Stadien nicht zu zweifeln, die ihm vorgelegen haben, aber in meinem Material fehlen. Er gibt darüber an, wie schon erwähnt, daß das Pigment der Larven nach der Resorption des Dottersacks eine wesentliche Rückbildung erfährt, wie das häufig bei Entwicklungsstadien dieser Stufe der Fall ist. Bei den jüngsten Larven bilden die Pigmentpunkte zwischen dem After und dem Schwanze eine ziemlich kontinuierliche Reihe und sind auch längs der Rückenlinie und an den Seiten vorhanden. Die letzteren verschwinden zunächst nach der Resorption des Dottersacks, und später erfahren dann auch die an der Ventralkante liegenden Punkte eine gewisse Reduktion.

Im Allgemeinen läßt sich zur Charakteristik der Auxislarven etwa folgendes sagen.

Wie alle Thynnidenlarven — und im Gegensatz zu den Scomberlarven — ist auch Auxis durch einen großen Kopf und durch starke Bedornung des freien Präoperkularrandes ausgezeichnet; doch bleibt der Kopf in der relativen Größe weit hinter demjenigen der Orcynusarten zurück, auch ist der Körper der Larve gestreckter als derjenige der Orcynuslarven. Die Kiefer sind mit zahlreichen kräftigen Zähnen besetzt, dagegen zählt man im Gaumen bei der 12 mm langen Larve nur 2 bis 3 Zähnchen jederseits. Die 1. D. gelangt früher als bei Scomber aber später als bei Orcynus zur Ausbildung und jedenfalls nicht früher als die anderen unpaaren Flossen. Sie ist zunächst pigmentlos und beginnt erst bei etwa 11 mm Totallänge sich mit zierlichen Chromatophoren zu bedecken.

Der Eingeweidesack ist stark zusammengedrückt und fängt erst bei etwa 8 mm Totallänge an, sich nach hinten auszudehnen; dabei wird dann der sehr große Postanalraum etwas verkleinert; doch ist derselbe auch noch bei der 12 mm langen Larve verhältnismäßig groß.

Sehr charakteristisch ist die Anordnung des Pigments auf dem Hinterkörper, wennschon die Intensität desselben sehr wechselnd ist. Hierin sind die Auxislarven den Scomberlarven ähnlicher als den Orcynus. Zunächst nach der Dotterresorption sind nur einige charakteristisch geordnete Punkte in der dorsalen und ventralen Körperkontur vorhanden, später entsteht daraus je eine dichtere Reihe, die dorsal stärker ist als ventral. Auch über und neben der Wirbelsäule verlaufende Pigmentreihen sind bei den älteren Larven vorhanden.

Verzeichnis der beobachteten Larven von Auxis thazard Lacép.

J. Nr.	Zeit	Ungefähre Ortsangabe	Gerät und Länge der Leine	Zahl der Larven	Größen in mm	Bemerkungen
123	3/7 10	S. v. Genua	Ytr. 10 m	1	6,3	
126	10/7 10	W. Insel Elba	— 25 -	1		?
154	29/7 10	Küste d. Cyrenaika	— 25 -	2	7,2; 9,7	
182	13/8 10	S. Spitze v. Euboea	— 10 -	2	6,3; 6,5; 8,0; 8,0	
			— 65 -	1		
			— 600 -	1		
197	24/8 10	SW. Insel Ischia	— 25 -	1	6,6	
206	28/8 10	O. d. Balearen	— 25 -	1	5,2; 6,8; 11,6	Fig. 8c und 8e
			— 2000 -	2		
209	29/8 10	N. Mallorca	— 100 -	1	6,3	?
213	31/8 10	NW. d. Pityusen	— 25 -	13	6—12	Fig. 8g
			— 95 -	2		
215	31/8 10	» » »	— 25 -	28	6–12	Fig. 8a, b, d und f.
221	4/9 10	b. Oran	— 25 -	2	6,0; 8,6	
222	4/9 10	» »	— 25 -	4	6,0; 6,0; 7,0; 7,4	
223	5/9 10	» »	— 25 -	3	5,0; 6,0; 6,7	
227	6/9 10	b. Malaga	— 25 -	5	5; 6; 7; 7,5; 8,5	
228	7/9 10	SO. v. Gibraltar	1½ m 25 -	3	7,5; 8; 9	
339	30/8 11	N. der Balearen	Netz 108 -	40	4 - 8	Larven schlecht erhalten
341	27/8 11	SO. von Kreta	2 m Netz 28 -	2	4,8; 5	
529	5/8 12	NO.seite von Malta	Ytr. 57 -	16	5—10	
494	16/5 12	400 Ml. NO. v. St. Thomas	— — -	1	5,7	

SCOMBEROMORUS SPEC.

Die wirtschaftlich außerordentlich wichtige Art Scomberomorus maculatus Mitch., welche in den Vereinigten Staaten unter dem Namen Spanish mackerel wohl bekannt und nach dem Studium ihrer Entwicklungsgeschichte von JOHN A. RYDER sogar zu einem Gegenstand der künstlichen Fischzucht geworden ist, scheint unter unserem Larvenmaterial nicht vertreten zu sein, aber bei meiner Umfrage nach Entwicklungsstadien von Scombriden in unseren großen Museen erhielt ich vom Berliner Museum drei silberglänzende Jungfische von 103, 77 und 73 mm Länge, welche von der afrikanischen Küste bei Togo herstammen, und welche möglicherweise dieser Art und sicherlich der Gattung Scomberomorus zuzurechnen sind.

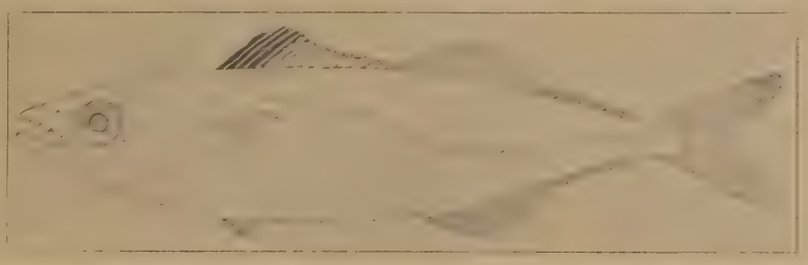

Fig. 9a. Scomberomorus spec. Togo. 73,0 mm lang. Vergr. 1,5 ×.

Die Zählung der Flossenstrahlen bei den drei Jungfischen ergibt folgendes Bild. 1. D.: 16 bis 17, 2. D.: 16 bis 17 + VIII, A.: 16 bis 17 + VIII, V: 6/6, P: 22/22. Vert: 19 + 27 = 46.

JORDAN und EVERMANN geben folgende Zahlen für Sc. maculatus: 1. D. 17, 2. D. 18 + IX, A: 2/17 + IX und für den verwandten Sc. regalis Bloch: 1. D. 17, 2. D. 1/15 + VIII, A. 2/14 + VIII.

Hiernach wäre es wahrscheinlicher, daß unsere Exemplare zu Sc. regalis gehörten. Der Umstand, daß der vordere Teil von 1. D. schwarz ist, kann zur Unterscheidung von Sc. maculatus und Sc. regalis nicht benutzt werden, wie mir John T. NICHOLS vom American Museum of Nat. History New York freundlichst mitteilte; andererseits war eine neuere Wirbelzählung für den amerikanischen Sc. maculatus nicht zu erhalten, und die einzige darüber existierende Angabe von VALENCIENNES, der 20 + 25 = 45 angibt, läßt es gegenüber meiner oben angegebenen Zählung (19 + 27 = 46) auch zweifelhaft erscheinen, ob mir wirklich Sc. maculatus und nicht vielmehr Sc. regalis vorgelegen hat.

Fig. 9b. Scomberomorus spec. Togo. 73,0 mm lang. Präopereulum. Vergr. 3,0 ×.

Was nun das Vorkommen dieser Formen vor der afrikanischen Küste anbetrifft, so gibt GRUVEL u. a. an, daß bei den Kanarischen Inseln besonders Sc. maculatus und Sc. tritor häufig seien, und VINCIGUERRA ist geneigt, diese beiden zu identifizieren, was wohl nicht berechtigt ist, da tritor vielmehr synonym mit Sc. cavalla Cuv. ist, dem eine einfarbige 1. D. zugeschrieben wird.

Der Verlauf der Seitenlinie bei unseren jungen Exemplaren von Togo ist zwar sehr eigentümlich, kann aber nicht als Unterscheidungsmerkmal für die beiden hierin sehr ähnlichen Arten maculatus und regalis dienen.

Nach allem ist es nicht sicher, daß unsere Jugendformen als zu Sc. maculatus gehörig anzusehen sind.

Sehr bemerkenswert sind die Reste der Präopercularbewaffnung, welche in Fig. 9b noch einmal wiedergegeben sind. Sie lassen darauf schließen, daß bei früheren Entwicklungsstadien die Dornen des Präoperculum in ähnlicher Zahl und Anordnung ausgebildet sind wie bei den andern Thynniden. Bei unseren Scomberomorus sind noch 5 stumpfe Fortsätze in charakteristischer Anordnung am Präopercularrand erkennbar.

Von der amerikanischen Spanish mackerel, welche, wie erwähnt auch künstlich erbrütet wird, ist bekannt, daß die mit einer Ölkugel versehenen Eier nur 0,90 bis 1,15 mm im Durchmesser groß sind, und daß sie sich bei 25° C. in der unglaublich kurzen Zeit von 25 Stunden entwickeln. Die jüngsten Larvenstadien sind von J. A. RYDER l. c. abgebildet.

SPECIES INDETERMINATA.

Bei Station 561 nordöstlich von Cap S. Roque an der brasilianischen Küste, unter 0° 39′ S. 31° 23′ W. wurden am 9. 7. 1912 einige Larven gefangen, die ihrem allgemeinen Habitus nach unzweifelhaft als Thynniden Larven angesehen werden konnten, deren specielle Zugehörigkeit aber, angesichts der Unmöglichkeit die Wirbelzahl auszumachen, nicht festgestellt werden konnte. Ein Netzzug mit 23 m Leine brachte vier, ein solcher mit 56 m Leine drei dieser Larven, die leider alle nicht gut erhalten sind.

Fig. 10a. Species indeterminata. Brasilianische Küste (St. 561) 9. VII. 1912. 7,8 mm lang. Vergr. 15,0 ×.

Die Größen der Fischchen liegen zwischen 5 und 8 mm.

Alle sind durch einen großen Kopf, schwache Präoperkular-Bewaffnung und umfangreichen Eingeweidesack ausgezeichnet, und die letztere Eigentümlichkeit trennt sie von den bisher behandelten Thynniden. Möglich, daß sie den Cybiiden zuzurechnen sind.

Die 8 mm lange Larve (Fig. 10a) besitzt etwa 16 bis 18 Kieferzähne oben und unten jederseits und daneben 6 Gaumenzähne. Die Narinen sind noch konfluent. Die Präoperkulardornen sind sehr zart, drei mittlere nahezu gleich lange ragen weit auf den Eingeweidesack herauf, nach oben und unten stehen noch je 2 kleinere Dornen; auch am Hinterrand der Otocyste steht ein nach hinten gerichteter Dorn. Der Eingeweidesack ist, wie erwähnt, sehr groß und eigentümlich aufgebläht.

Fig. 10b. Species indeterminata. Brasilianische Küste (St. 561) 9. VII. 1912. 5,4 mm lang. Vergr. 18,0 ×.

Die unpaaren Flossen sind alle angelegt; in der 1. D. sind etwa 8 bis 9 mittellange zarte Strahlen kenntlich, deren Flossensäume noch pigmentlos sind; nur beim größten Exemplar ist ein späteres Auftreten von Pigment schwach angedeutet. Der Analabstand der Afterflosse ist nicht sehr groß. Die Brustflossen sind wie gewöhnlich ziemlich groß, erreichen aber den After nicht; die Bauchflossen sind noch sehr klein und wenig entwickelt.

Charakteristisch ist die Pigmentverteilung. Dieselbe erreicht im Peritoneum und im Kopf, namentlich in der Umgebung des Gehirns den gewöhnlichen Umfang; besonders bemerkenswert aber sind 2 kleine Pigmentpünktchen an der Basis der Analflößchen und einer an der Basis der Schwanzflosse.

Ein kleineres Exemplar von 5,4 mm Länge, welches in Fig. 10b festgehalten ist, zeigt genau die gleiche Pigmentierung und auch einige Pigmentsterne in den Kieferspitzen. Die unpaaren Flossen sind hier noch wesentlich unentwickelter, die 1. D. ist nur als schmaler Saum vorhanden, die Schwanzflosse als heterocerke Anlage unter dem fast horizontal verlaufenden Urostyl. Die Brustflossen reichen nach hinten noch etwas über den After heraus.

Bei den kleinsten Larven von kaum 5 mm Länge erreicht die Zahl der Zähne kaum 10; die Flossensäume sind noch embryonal und lassen kaum die ersten Spuren der Strahlenentwicklung erkennen, auch in der Schwanzflosse.

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REPORT ON THE DANISH OCEANOGRAPHICAL EXPEDITIONS 1908—10
TO THE MEDITERRANEAN AND ADJACENT SEAS

Vol. II. Biology.

D. 4.

Hyperiidea-Amphipoda

(part 2: *Paraphronimidæ, Hyperiidæ, Dairellidæ, Phronimidæ, Anchylomeridæ*)

by

K. Stephensen.

With 20 figures and 15 charts in the text.

Published, August, 1924.

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I. INTRODUCTION

The present paper includes part 2 of *Hyperiidea* from the "Thor"-Expeditions (part 1. is contained in vol. II. D. 2. 1918). Together with part 3, which will be published shortly, I hope, this paper was sent to the Editor in Sept. 1918, but on account of the raised prices for printing it was left unprinted till now. This is also the reason why, generally speaking, no reference has been made to the (very few) papers published since 1918; only the list of literature at the end of the paper has been brought up to date.

For further details see Introduction to vol. II. D. 2. p. 3 *seq.*, 1918.

A complete list of all the stations of the Expeditions is found in Dr. Johs. Schmidt's Introduction vol. I, pp. 26—49, with chart.

A few stations from 1908—10 are situated N. of the area of the two charts reproduced here (charts 8—9), viz:

St. 1—3, 77, 246—47: N. and W. of Bretagne,

St. 78, 248, 249: English Channel, central and eastern parts,

St. 75, 76, 79, 80, 241—45: Bay of Biscay.

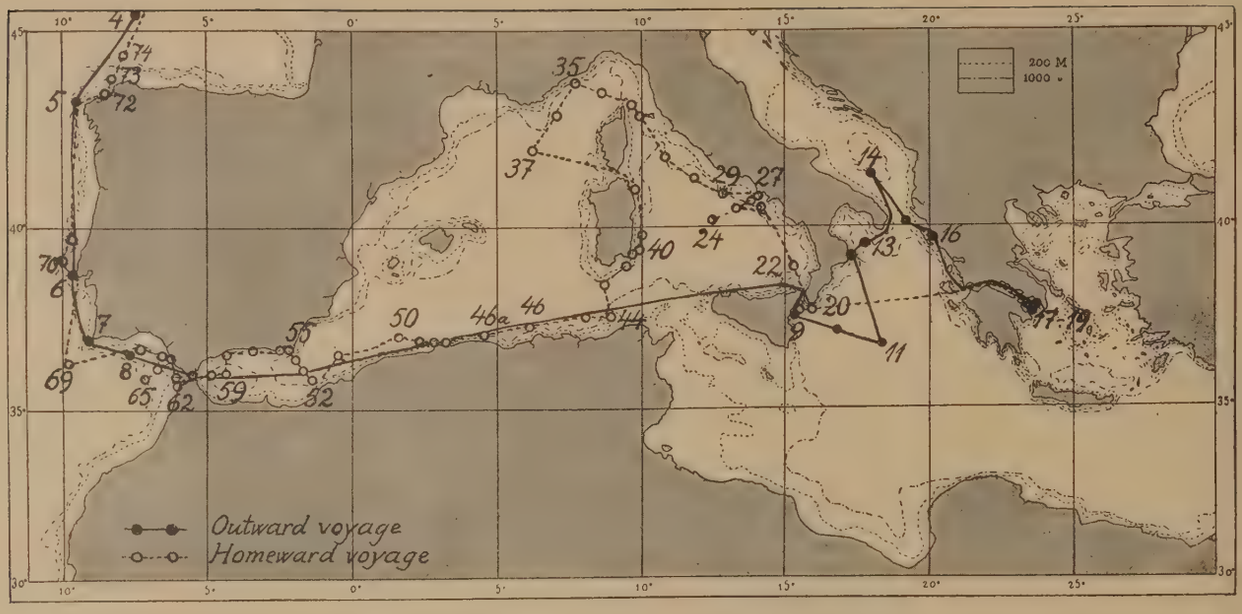

Chart 8. The Stations of the Winter Cruise 1908—1909.

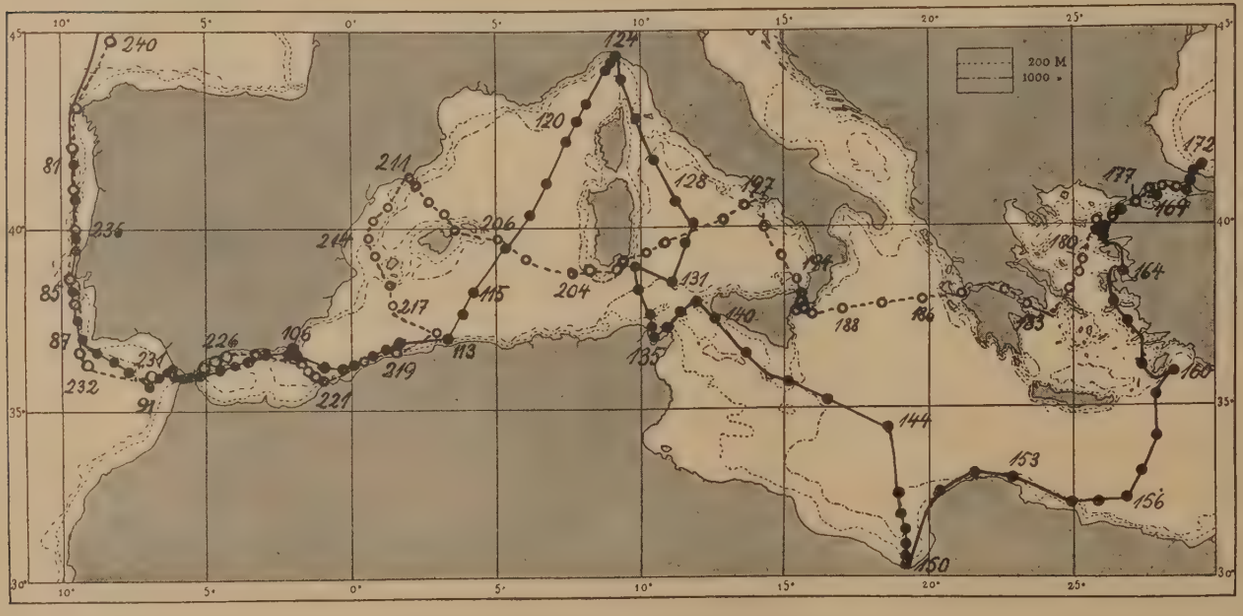

Chart 9. The Stations of the Summer Cruise 1910.

II. THE FAMILIES AND SPECIES

Fam. Paraphronimidæ Bovallius.

Paraphronimidæ Bovallius, Syst. list 1887, p. 13. — *P.* Stebbing 1888, p. 1335. — *P.* Bovallius 1889, p. 20 (lit. and key to the genera). — *P.* Vosseler 1901, p. 94.

The family comprises two genera with four species; the "Thor"-Expedition has taken the only two well-known species.

1. Genus Paraphronima Claus.

Paraphronima Claus, Zool. Anzeiger, Jahrg. 1, No. 12, 1878, p. 269. — *P.* Claus, Phronimiden 1879, p. 64 (6). — *P.* Stebbing 1888, p. 1335. — **P.* Bovallius 1889, p. 23 (lit. and key to the species).

1. PARAPHRONIMA GRACILIS Claus (Chart 10.)

Paraphronima gracilis Claus l. c. 1879, p. 65 (7), Pl. 1 figs. 4—5. — **P. g.* Bovallius 1889, p. 27, Pl. 2 figs. 1—10. — *P. g.* Vosseler 1901, p. 95. — *P. Edwardsii* Bovallius 1885, p. 12. — *P. cuivis* Stebbing 1888, p. 1337, Pl. 157. — *P. g.* Spandl 1924, p. 263, fig.

Mediterranean.

St. 152. 27-7-1910. 300 m.w., 11^{35} pm., 30 min. 1 ♀ with great marsupium. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 1 jun. — **St. 163.** 3-8-1910. Surf. (P. 100), 0^{15} am., 10 min. 2 jun. — **St. 163.** ibid. 300 m.w., 1^{05} am., 15 min. 1 ♂. — **St. 163.** ibid. 1000 m.w., 0^{05} am., 30 min. 1 ♀ with great marsupium. — **St. 178.** 12-8-1910. 65 m.w., 0^{20} pm., 15 min. 2 ♂. — **St. 181.** 13-8-1910. 300 m.w., 1^{25} pm., 20 min. 1 ♂. — **St. 182.** 13-8-1910. 600 m.w., 11^{40} pm., 30 min. 2 ♀ with great marsupium. — **St. 194.** 21-8-1910. 10 m.w., 4^{30} am., 15 min. 1 ♀ with great marsupium. — **St. 276.** 36°30′ N, 19°20′ E, 4-4-1911. 132 m.w. (S. 200); 11^{20} pm., 35 min. 10 spec.: 8 ♂, 1 ♀, 1 jun. — **St. 297.** 33°10′ N, 25°35′ E, 25-6-1911. 28 m.w. (S. 200), 11^{30} pm., 30 min. 1 ♂. — **St. 298.** 34°20′ N, 21°10′ E, 26-6-1911. 38 m.w. (S. 200), 11^{30} pm., 30 min. 2 ♂. — **St. 341.** 34°00′ N, 26°20′ E, 27-8-1911. 28 m.w. (S. 200), 11^{00} pm., 30 min. 2 ♂. — **St. 384.** 32°50′ N, 27°10′ E. 7-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 1 ♂, 1 ♀ with great marsupium.— **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 15 spec.: 11 ♂, 3 ♀ with great marsupium (1 with ova), 1 ♀ jun. — **St. 412.** 34°33′ N, 24°13′ E. 7-1-1912. 112 m.w. (S. 150), 6^{30} pm., 30 min. 2 ♀ with great marsupium, 2 jun. — **St. 699.** 36°00′ N, 18°58′ E. 7-2-1913, 5^{00} am. 2 ♀ with great marsupium. — **St. 729.** 41°00′ N, 17°44′ E. 14-4-1913. 3 ♀ with great marsupium.

Atlantic.

St. 65. 24-2-1909. 65 m.w., 6^{30} am., 60 min. 1 ♂. — **St. 65.** ibid. 600 m.w., 10^{00} am., 120 min. 1 ♀ with great marsupium. — **St. 69.** 28-2-1909. 65 m.w., 10^{45} pm., 30 min. 3 spec.: 1 ♂ jun., 2 ♀ with marsupium. — **St. 89.** 18-6-1910. 1000 m.w. (S. 200), 4^{10} am., 30 min. 1 ♀. — **St. 91.** 18-6-1910. 1600 m.w., 5^{25} pm., 60 min. 1 ♀ with great marsupium. — **St. 264.** 38°14′ N, 24°34′ W. 19-3-1911. 25 m.w. (S. 150), 7^{00} pm., 30 min. 3 spec.: 2 ♂, 1 ♀ with embryos. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 8^{45} pm., 30 min. 32 spec.: 20 ♂, 12 ♀ (1 with embryos, 1 with ova). — **St. 376.** ibid. 30 m.w. (S. 100), 8^{10} pm., 30 min. 4 spec.: 1 ♂, 3 ♀. — **St. 377.**

Chart 10. *Paraphronima gracilis* and *P. crassipes*. 8 stations lie outside the Chart to the S.W.

31°23′ N, 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 8^{05} pm., 30 min. 24 spec.: 17 ♂, 4 ♀, 3 jun. — **St. 382.** 34°21′ N, 16°24′ W, 23-10-1911. 22 m.w. (S. 100), 6^{05} pm., 30 min. 1 ♀. — **St. 383.** 37°16′ N, 14°09′ W. 23-10-1911. 300 m.w. (S. 100), 6^{30} pm., 30 min. 11 spec.: 5 ♂, 6 ♀. — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. Surf. (S. 200), 1^{10} am., 30 min. 1 ♂, 1 ♀. — **St. 398.** ibid. 56 m.w. (S. 150), 0^{40} am, 30 min. 1 ♂. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911, 56 m.w. (S. 150), 9^{10} pm., 30 min. 9 spec.: 2 ♂, 7 ♀ (2 with ova, 1 with embryos). — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 10^{05} pm., 30 min. 1 ♂, 1 ♀ with embryos. — **St. 400.** ibid. 56 m.w. (S. 150), 9^{35} pm, 30 min. 2 ♂.

The "Thor" collections yield in all 151 specimens (83 ♂, 59 ♀, 9 jun.) from 28 stations, 34 hauls.

A. Mediterranean.

The material comprises 53 spec. (29 ♂, 18 ♀, 6 jun.), from 16 stations, 18 hauls.

Depths of the sea and occurrence (Chart 10). The species, which is new to the Mediterranean, seems to occur at all depths of the sea, except the lowest; only one station is less than 200 m (i. e. 68 m: St. 178).

All stations with the exception of one (St. 194) lie in the eastern basin, where the distribution of stations is as in the case of *P. crassipes*, and it enters the Adriatic (St. 729) and penetrates as far as the Dardanelles (St. 178). The only station in the western basin (St. 194) lies close to the north of the Strait of Messina; but the Zoological Museum at Copenhagen has long possessed a hitherto undetermined specimen from Naples, presented by Prof. Dr. P. Mayer. With this distribution it is sharply distinguished from *P. crassipes*, which is evenly distributed over both basins. The "Thor" only found it in the summer, but the other vessels likewise found it during winter and spring (Nov.—April).

Vertical occurrence. Of the 18 hauls in all, the length of line is not given in the case of 2; of the remaining 16 hauls there are two day hauls with 65 and 300 m. w. respectively; of the 14 night hauls, 6 have a length of wire of 10—38 m.

Size and propagation. The sizes generally vary between 6—7—8 mm; the only female with ova was taken on Nov. 9. (St. 385).

B. Atlantic.

The "Thor" material comprises 98 specimens in all (54 ♂, 41♀, 3 jun.) from 12 stations, 16 hauls. The depths of the sea are great, > 1100—> 4500 m. The northern limit is in the Bay of Cadiz, at about 36½° N.; the other stations are S.W. of the latter. The vertical occurrence is the same as in the Mediterranean, and ♀ with ova or embryos are found from March to the end of October. The species is new to the area of the "Thor" in the Atlantic.

Several of the hauls in the Atlantic are peculiar on account of the large number of individuals, though otherwise only few specimens of the species have been taken at a time: 3 hauls (each of 30 min.) yielded 32, 24 and 11 specimens respectively.

Distribution.

Mediterranean (almost exclusively eastern basin); Atlantic ca. 40° N—17° S; Indian Ocean; temperate and tropical regions of the Pacific.

1. Mediterranean; see above.

2. Atlantic. "Thor", see above. — Without special locality, 1 ♀ (Claus 1879). — Canaries (Chun, 1889, p. 532). — 6 localities 39⅓°—42° N, 33½°—45½° W, 5 ♂, 6 ♀ (Chevreux, 1900). — 34°22′ N, 34°23′ W. surf., 1 ♂ (Stebbing, "Challenger"). — Vosseler enumerates 49 spec. (28 ♂, 21 ♀) from 32 hauls from the German Plankton-Exped. from the following localities: Florida Current 2 hauls 40.4° N, 57° W, 0—200 m. w.; Sargasso Sea 9 localities: 37.1° N, 59.9° W; 35° N, 62.1° W; 31.5° N, 45.6° W, to 27.8° N, 33° W; 30.8° N, 30.9° W; 0—400 (0—200) m. w. N. Equatorial Current 10 hauls 28.9° N, 35° W, to 10.2° N, 22.2° W; 12° N, 40.3° W; 0—400 (or 0) m. Guinea Current 3 hauls: 5.3° N, 19.9° W; 3.6° N, 19.1° W; 9.4° N, 41.9° W; 0—400 m. S. Equatorial Current 7 hauls: 0° N, 15.2° W, to 7.8° S, 17.3° W, and 4.4° S, 29.2° W, 0—400 m; Gulf Stream, 1 haul 37.7° N, 25.2° W, 0—80 m. — 10°55′ N, 17°46′ W, surf., 1 ♂ (Stebbing, "Challenger"). — 7°37′ N, 22°26′ W, Reinhardt leg., Bovallius determ, 2 spec., and 7° N, 30° W, Reinhardt leg. 1852, 1 spec. (in our Zool. Museum). — 17°15′ S, 32°05′ W, 1 ♂ (Stewart 1913).

3. Indian Ocean. Walker enumerates (1909—10, p. 52) 9 spec. from the following localities: 4 and 6 miles NW of entrance into Desroches Atoll (Amirante), 750 fms. w., 1 spec., and 200 fms. w., 1 spec. 11 mm; 8°16′ S, 51°26′ E, 140 fms. w., 1 ♂; 10°27′ S, 51°17′ E, 200 fms. w., 1 ♀, and 350—0 fms., 1 spec.; Mauritius, W of Black River, 25 fms. w., 1 jun.; 7 miles NW of Yeye, Peros Atoll (S of Maldive Archipelago), 600 fms. w., 1 spec.; 4°16′ S, 71°53′ E, 1200 fms. w., 1 spec.; 3°31′ S, 72°27′ E, 125 fms. w., 1 spec.

4. Pacific. The "Challenger" Exped. has taken the species at the following localities: NW Pacific without special locality 2 ♂, 1 ♀; 36°42′ N, 179°50′ W, surf., night, 2 ♂, 1 ♀; 36°23′ N, 174°31′ E, 1 ♂; 35°41′ N, 157°42′ E, surf., 2 ♀; Api (New Hebrides, 23° N, 168° E)

to Cape York (N. Australia, $9^1/_2{}^\circ$ N, $142^1/_2{}^\circ$ E), 1 spec.; 7°17′ N, 147°20′ W, 1 ♂; 13°50′ S, 151°49′ E, surf., 1 ♂ jun.

2. PARAPHRONIMA CRASSIPES Claus (Chart 10, p. 75).

Paraphronima crassipes Claus, Phronimiden 1879, p. 65 (7), 66 (8), Pl. 1 figs. 6—9, Pl. 2 fig. 10. — **P. c.* Bovallius 1889, p. 31, Pl. 2 fig. 1. — *P. c.* Vosseler 1901, p. 97, Pl. 8 figs. 22—26. — *P. c.* Stewart 1913, p. 253. — *P. clypeata* Bovallius 1885, p. 11 fig. 3. — *P. cl.* Bovallius 1889, p. 33, Pl. 2 figs. 16—40. — *P. pectinata* Bovallius, Syst. list 1887, p. 13.

Mediterranean.

St. 58. 20-2-1909. 100 m.w., 2^{00} pm., 30 min. 2 ♂. — **St. 108.** 25-6-1910. 300 m.w., 10^{30} pm., 30 min. 2 ♂. — **St. 113.** 28-6-1910. 300 m.w., 3^{25} am., 30 min. 2 ♂. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 1 ♂. — **St. 118.** 1-7-1910. 25 m.w., 0^{20} am., 15 min. 6 ♂. — **St. 118.** ibid. 300 m.w., 5^{55} pm., 30 min. 2 ♂. — **St. 121.** 2-7-1910. 25 m.w., 3^{35} am., 30 min. 1 ♂. — **St. 123.** 3-7-1910. 25 m.w., 1^{50} am., 15 min. 1 ♂. — **St 123.** ibid. 65 m.w., 0^{55} am., 30 min. 1 ♂, 2 ♀ (1 with ova). — **St. 122.** 2-7-1910. 1200 m.w., 5^{30} pm., 60 min. 1 ♂. — **St. 125.** 9-7-1910. Surf. (P. 100), 10^{40} pm., 10 min. 1 ♂. — **St. 132.** 14-7-1910. 600 m.w., 4^{50} am., 30 min. 1 ♂. — **St. 133.** 14-7-1910. 300 m.w., 10^{15} pm., 30 min. 1 ♂, 2 ♀. — **St. 135.** 16-7-1910. 25 m.w., 12^{55} am., 30 min. 1 ♂. — **St. 137.** 19-7-1910 250 m.w., 9^{05} am., 30 min. 2 ♂, 1 ♀. — **St. 141.** 20-7-1910. 25 m.w., 10^{35} pm., 15 min. 1 ♂. — **St. 144.** 24-7-1910. 4000 m.w., 6^{20} am., 60 min. 1 ♀ with great marsupium. — **St. 147.** 25-7-1910. 25 m.w., 11^{35} pm., 30 min. 1 ♂. — **St. 147.** ibid. 300 m.w., 0^{20} am., 30 min. 2 ♂, 1 ♀. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 3 ♂, 3 ♀ (1 with ova). — **St. 163.** 3-8-1910. 1000 m.w., 0^{05} am., 30 min. 1 ♂, 1 ♀ with embryo. — **St. 178.** 12-8-1910. 65 m.w., 0^{20} pm., 15 min. 5 ♂. — **St. 181.** 13-8-1910. 300 m.w., 1^{25} pm., 20 min. 1 ♂. — **St. 182.** 13-8-1910. Surf. (P. 100), 10^{35} pm., 10 min. 1 ♂. — **St. 182.** ibid. 10 m.w., 11^{00} pm., 15 min. 1 ♂. — **St. 182.** ibid. 600 m.w., 11^{40} pm., 30 min. 4 ♂, 2 ♀ (1 with great marsupium). — **St. 183.** 16-8-1910. 300 m.w., 4^{45} pm., 15 min. 1 ♂. — **St. 187.** 18-8-1910. 25 m.w., 7^{45} pm., 15 min. 2 ♂, 1 ♀. — **St. 194.** 21-8-1910. 25 m.w., 5^{00} am., 15 min. 2 ♂. — **St. 194.** 1200 m.w., 6^{00} am., 30 min. 1 ♂. — **St. 195.** 21-8-1910. 65 m.w., 6^{50} pm., 15 min. 1 ♂. — **St. 197.** 24-8-1910. 25 m.w., 7^{45} pm., 15 min. 3 ♂, 1 ♀. — **St. 204.** 27-8-1910. 65 m.w., 4^{30} am., 15 min. 1 ♂. — **St. 206.** 28-8-1910. 25 m.w., 0^{30} am., 15 min. 2 ♂. — **St. 210.** 30-8-1910. 25 m.w., 2^{45} am., 30 min. 1 ♂. — **St. 223.** 5-9-1910. 25 m.w., 4^{35} am., 15 min. 1 ♂, 1 ♀. — **St. 298.** 34°20′ N, 21°10′ E. 26-6-1911. 38 m.w. (S. 200), 11^{30} pm., 30 min. 4 ♂, 1 ♀. — **St. 339.** 40°30′ N, 3°10′ E. 20-8-1911. 28 m.w. (S. 200), 3^{00} am., 30 min. 1 ♀ with great marsupium. — **St. 340.** 35° 50′ N, 21°30′ E. 26-8-1911. 108 m.w. (S. 150), 9^{00} pm., 30 min. 2 ♂, 2 ♀. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 1 ♂, 1 ♀. — **St. 410.** 37°10′ N, 1°18′ W. 29-12-1911. 112 m.w. (S. 150), 7^{00} pm., 30 min. 2 ♂, 2 ♀. — **St. 412.** 34°33′ N, 24°15′ E. 7-1-1912. 112 m.w. (S. 150), 6^{30} pm., 30 min. 3 ♂, 1 ♀. — **St. 718.** 36°13′ N, 13°53′ E. 17-5-1913. 8^{15} pm., 1 ♂. — **St. 729.** 41°00′ N. 17°44′ E. 14-4-1913. 11^{30} pm., 1 ♀.

Atlantic.

St. 69. 28-2-1909. 65 m.w., 10^{45} pm., 30 min. 2 ♂. — **St. 69.** ibid. 600 m.w., 9^{00} pm., 60 min. 1 ♀ with ova. — **St. 89.** 18-6-1910. 1000 m.w., 4^{10} am., 30 min. 1 ♀. — **St. 95.** 23-6-1910. 300 m.w., 5^{10} am., 30 min. 1 ♂. — **St. 377.** 31°23′ N, 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 8^{05} pm., 30 min. 6 ♂, 6 ♀. — **St. 398.** 38°48′ N, 14°22′ W. 26-10-1911. Surf. (S. 200), 1^{10} am., 30 min. 1 ♂, 1 jun. — **St. 398.** ibid. 56 m.w. (S. 150), 12^{40} am., 30 min. 1 ♀ with ova. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. 2 ♂, 2 jun. — **St. 399.** ibid. 56 m.w. (S. 150), 9^{10} pm., 30 min. 2 ♀ (1 with ova).

The material comprises in all 124 specimens (85 ♂, 36 ♀, 3 jun.) from 44 stations, 52 hauls.

A. Mediterranean.

	No. of stations	No. of hauls	No. of specimens ♂	♀	Total
"Thor" Feb. 1909	1	1	2	..	2
— June 1910	3	3	5	..	5
— July —	12	15	22	7	29
— Aug. —	13	16	30	8	38
— Sept. —	1	1	1	1	2
"Thor" total	30	36	60	16	76
Other vessels	8	8	13	9	22
	38	44	73	25	98

Depths of the sea and occurrence. The species is fairly evenly distributed throughout all depths of the sea between about 100 and 3000 m. The 7 stations 0—500 m have the following depths: 68, 85, 175—195, 200, 233, 255 and 480 m.

As regards geographical occurrence (Chart 10, partim, p. 75) the 30 stations of the "Thor" are so distributed that 20 stations lie in the western and 10 in the eastern basin, and the stations are spread over the whole of the distance from Gibraltar to the Dardanelles; as the "Thor" herself has twice as many stations in the western as in the eastern basin they are thus to be found in fairly equal numbers in the two basins. The 8 supplementary stations where investigations have been made by other vessels do not add to the distribution, apart from a single station (St. 729) situated in the southern Adriatic. All the positive hauls of the "Thor" with one exception (St. 58), were made during the summer only; but among the supplementary hauls from other vessels there are 3 winter hauls (St. 385, 410, 412).

Vertical occurrence. During the night, the species keeps almost exclusively to the upper water layers (10—35 m. w.). During the day, it has not been taken nearer the surface than with 65 m. w.; the 3 positive hauls with the smallest length of line were made with 65 (2 hauls) and 100 m. w.

Size and propagation. The size is generally 6—7—8 mm, and ♀ is often a little larger than ♂, as much as 10 mm in fact. There are about 3 times as many ♂ as ♀. Among the 25 ♀ there are only 3 with ova or embryos, taken on July 3rd and Oct. 3rd respectively.

B. Atlantic.

There are in all 26 specimens (12 ♂, 11 ♀, 3 jun.) from 6 stations, 8 hauls. From this scanty material it is impossible to deduce anything for certain; ♀ with ova were found on Feb. 28th and Oct. 26th. The species is new to this region of the Atlantic.

Distribution.

Mediterranean; Atlantic; Pacific.

1. Mediterranean. "Thor", see above. — Without special locality, 1 ♀ (Claus l. c.) — Vosseler, in Lo Bianco 1903—04, p. 278, enumerates 17 spec. from 9 day hauls, Feb. 5th to May 10th; 7 hauls are from the Gulf of Naples, 500—2000 m. w.; and 3 of them were taken with closing net 50, 100 and 200 m. w.; 1 haul is from Salina (Eolian Islands), 2500 m. w., and 1 haul from Stromboli, 1100 m. w. *Ibid.* p. 238 it is mentioned from 11 hauls, three of them 50—100 m (closing net). — Ponza, Ischia, Capri, 800—1300 m. w., in Jan., 40 and 900 m. w. (Chun, Bibl. Zoologica 1888).

2. Atlantic. Our Zool. Museum has 37 spec. from the following localities: 39°10′ N, 42°10′ W, Andrea 1863, 1 spec.; 36°6′ N, 39°28′ W, Warming 1866, 1 spec.; 36° N, 43° W, "Galatea" 23-7-1847, 1 spec.; 33° N, 47° W, "Galatea" 17-7-1847, 1 spec; 30°34′ N, 30°50′ W, Andrea 1862, 1 spec.; 26° N, 26° W, Iversen 1871, 1 spec.; 25° N, 39° W, Hygom 1863, 1 spec.; 24°—25° N, 31°—33° W, Iversen, 1 spec.; 11°45′ N, 27° W, abt. 15 spec.; 10°22′ N, 21°16′ W, 2 spec.; 10° N, 30° W, Reinhardt 1852, 4 spec.; 8°44′ N, ?W, Reinhardt, 1 spec.; 7°37′ N, 22° W, Reinhardt, 4 spec.; 7° N, 30° W, Reinhardt 4-7-1852, 1 spec.; 37° S, 7½° E, "Galatea" 5-9-1845, 2 spec. — Chevreux (1900) enumerates 17 spec. (6 ♂, 11 ♀) from 5 stations 40¾°—42° N, 39°—43¾° W, surf., night. — Vosseler enumerates (Plankton-Exped.) 17 spec. (9 ♂, 8 ♀) from 16 hauls: Florida Current 1 st. 40.4° N, 57° W, 0—200 m; Sargasso Sea 2 stations: 34.7° N, 62.4° W, 0 m, and 31.5° N, 40.7° W, 0—400 m; N. Equatorial Current 4 st. 28.9° N, 35° W to 10.2° N, 22.2° W, 0—400 (or 0) m; Guinea Current 3 st.: 5.9° N, 20.3° W, and 6.7° N, 43.2° W, 0—400 m; S Equatorial Current 6 st.: 0.1° N, 15.2° W to 5.1° S, 14.1° W, and there from to 0.1° N, 44.2° W, 0—400 m. — 37°33¾ S, 6°09′ E, 12 spec., and 37°47′ S, 3°59′ E, 1 ♀ (Stewart 1913).

3. Pacific. The tropical region of the Pacific (*P. clypeata*, Bovallius, Monogr.).

Fam. Hyperiidæ Dana.

Hyperiidæ K. Stephensen 1923, p. 13 (lit.)

Of the 9 genera of the family (in the following, *Euthemisto* has been considered synonymous with *Parathemisto*) with 45 (+ 3 doubtful) species, 6 genera with 18 species are represented in the "Thor"-material.

The table below shows where the species occur:

	Mediterranean	Atlantic
Hyperoche Kröyeri	—	×
— picta	×	(×)*
— mediterranea	×	..
Euiulopis Loveni	×	S*
Hyperia medusarum	—	×
— galba	(×)	×
— Fabrei	(?)	n*
— Luzoni	×	×
— schizogeneios	×	×
— crucipes	..	n
— macrodactyla n. sp.	n	..
— thoracica	..	n
— hydrocephala	×	n
Hyperioides longipes	×	×
Themisto gracilipes	×	×
— abyssorum	..	×
— compressa	?	×
Phronimopsis spinifera	×	×

* (×) = the species is known from the "Thor"-area, but not taken by the "Thor"-Exped.
S = the species is known from the Atlantic but only S. of the "Thor"-area.
n = new to the area in question.

From this it appears that all the species formerly found in the Mediterranean, excepting only *Hyperia galba* (*H. Fabrei* is doubtful) were also taken by the "Thor", and one species, *Hyperia macrodactyla*, is new to science.

All the 15 species known from the Atlantic area of the "Thor" (*Euiulopis Loveni* is only known from southern waters) with the exception of *Hyperoche picta* (of which hardly more than a single specimen is known from the

Atlantic) were found again by the "Thor", and 4 are new to the area viz. *Hyperia Fabrei*, *H. crucipes*, *H. thoracica* and *H. hydrocephala*, the four last-named species having previously only been found further south.

1. Genus Hyperoche Bovall.

Hyperoche K. Stephensen 1923, p. 13 (lit.).

1. HYPEROCHE MEDUSARUM Kr.

Hyperoche medusarum K. Stephensen 1923, p. 13 (lit.).

Atlantic.

St. 1. 94 m. 28-11-1908. 25 m.w. 2^{50} am., 30 min. 1 ♀ jun. 4 mm, 1 spec. jun. 2 mm. — **St. 76.** 1800 m. 10-3-1909. 25 m.w. 7^{15} pm., 30 min. 2 ♀ with ova 6 mm. — **St. 76.** ibid. 65 m.w. 6^{05} pm., 60 min. 1 ♀ with ova 5 mm. — **St. 247.** 100 m. 19-9-1910. 8^{40} pm. (P. 100), surf., 10 min. 3 ♂ ad., 6 mm.

Distribution. A boreo-arctic species (see K. Stephensen 1923, p. 13, with chart). Very rarely encountered at depths greater than 1000 fath. (Tattersall 1906), and it seems to keep quite close to the surface, at the utmost 250 m. down (Tesch 1911). Otherwise its biology is practically unknown.

2. HYPEROCHE MEDITERRANEA Senna (Fig. 33).

**Hyperoche mediterranea* Senna 1906, p. 159, figs. 1—10, Pl. 1 figs. 1—2 (cold. figs.) — **H. m.* Steuer 1911, p. 5, Pl. 11.

Mediterranean.

St. 116. (W. of Baleares). 29-6-1910. Surf. (P. 100), 4^{15} pm., 10 min. 4 spec. jun., 1.5—2 mm. — **St. 223.** (S. of Almeria). 5-9-1910. Surf. (P. 100), 4^{40} am., 10 min. 1 ♂ (jun.?) 4 mm. — **St. 227.** (N. by W of Gibraltar). 6-9-1910. Surf. (P. 100). 5^{40} pm., 10 min., 1 spec. juv., 2 mm.

As far as can be seen, the small specimens coincide very well with the descriptions of small specimens given by Senna and Steuer.

The size of the large specimen lies between the mature specimens (7 mm, Senna) and the young ones delineated by Senna and Steuer (2.5 and 2.7 mm respectively); consequently, and also in several other respects, it occupies an intermediate position. The antennæ are as long as in the adult form. The distal end of 3. free (properly speaking 4.) joint in p. 2 is like that of specimens of 2.5—2.7 mm, but not like that of the adult. In p. 3—p. 4 in particular 4.—5. free joints are somewhat shorter than on the adults, but longer than on the small specimens. In p. 5—p. 7 the dactylus is longer than shown by Senna and Steuer, both as far as the adult animals and the young stages are concerned, and 3.—4. free joint slightly heavier than in the adult animals of 7 mm. Pleopoda have 10 joints in the inner ramus, in the outer ramus 9 joints.

As there is no fig. of the urosome, I have drawn it here. Uropoda do not quite agree with Senna's description. In up. 1 the inner ramus is of the same length as

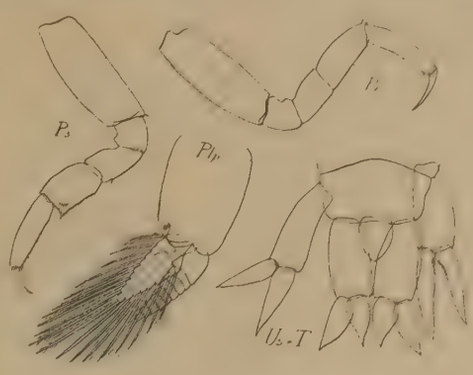

Fig. 33. *Hyperoche mediterranea* ♂ (ad.?).

the peduncle and slightly longer than outer ramus; the median margin of the two rami has a concave section in the proximal part, exactly as in certain species of *Hyperia* and in *Hyperioides*. Up. 2 reaches with its apex the apex of up. 3; the inner ramus is about three fourths the length of the very broad peduncle, and the outer ramus is a little shorter (about two thirds as long). In up. 3 the inner ramus is about two thirds the length of the very broad peduncle and the outer ramus a little longer. On the 3 pairs of uropoda the peduncle is totally smooth along the edge, with the exception of some small teeth at the distal part of the outer margin of up. 1, and on the distal part of the inner margin of up. 2—3. All the rami are serrated; the proximal half of the outer ramus in up. 1, however, and the total outer margin of the outer rami in up. 2—3 is quite smooth. The telson is elliptical, about half the length of the peduncle of up. 3.

The depths vary between 99—2860 m. All the specimen were taken at the surface.

Distribution. The "Thor"-specimens were taken in the western region of the Mediterranean. — Messina (Senna l. c.) — Rovigno, 1 spec. in *Beroë Forskâli* (Steuer l. c.).

3. HYPEROCHE PICTA Bovallius.

Hyperoche picta Bovallius 1889, p. 111, Pl. 7 figs. 32—35. — *H. p.* Senna, 1906, p. 168, textfigs. 11—20.

Mediterranean.

St. 730. > 1000 m. 38°26′ N, 13°37′ E. (N. of Sicilia). 16-4-1913. 2^{00} pm. 1 ♂ ad. 4 mm.

Distribution. Mediterranean: Messina, April—June 1903 and March 1904, several spec. (SENNA l. c.). Atlantic. 20° N, 39° W (BOVALLIUS l. c.).

2. Genus Euiulopis Bovall.

Iulopis Bovallius, Syst. list 1887, p. 17. — **Euiulopis* Bovallius 1889, p. 116 (key to the species).

Chart 11. × *Hyperia galba*, ● *Euiulopis Loveni*. S.W. of Ireland the stations for *H. galba* lie so close to each other that it was impossible to note them all. St. 265—67 and 270 lie outside the chart to the West.

1. EUIULOPIS LOVENI Bovallius (Chart 11, partim).

Iulopis Loveni Bovallius l. c. 1887, p. 17. — **Euiulopis L.* Bovallius 1889, p. 118, Pl. 8 figs. 1—8. — *E. L.* Senna 1906, p. 173, Pl. 1 figs. 1—3 (cold. fig.).

Mediterranean.

St. 47. 10-2-1909. 65 m.w., 10^{20} pm., 30 min. 1 ♂, 5 mm. — **St. 47.** ibid. 300 m.w., 1^{05} pm., 30 min. 4 ♂, 4—5 mm. — **St. 106.** 25-6-1910. 300 m.w., 1^{45} am., 30 min. 1 ♂ 5 mm, 2 ♀ 4—5 mm. — **St. 107.** 25-6-1910. Surface (P. 100), 7^{40} am. 10 min. 2 spec. juv. 2 mm. — **St. 107.** ibid. 65 m.w., 9^{50} am. 15 min. 1 ♂ juv. 4 mm, 7 ♀ 4—5 mm (2 of them with ova 5 mm). — **St. 108.** 25-6-1910. 25 m.w., 11^{55} pm., 15 min. 1 ♀(?) 3 mm. — **St. 108.** ibid. 65 m.w. 11^{15} pm. 30 min. 1 ♂ juv. 3.5 mm, 1 sp. juv. 2 mm. — **St. 112.** 27-6-1910. Surface (P. 100), 0^{20} am., 10 min. 1 sp. juv. 2 mm. — **St. 112.** ibid. 25 m.w., 1^{30} am., 15 min. 1 ♂ juv. 3.5 mm. — **St. 112.** ibid. 65 m.w., 1^{05} am., 15 min. 1 ♂ 5 mm., 1 ♀ 5 mm, 1 sp. juv. 2 mm. — **St. 112.** ibid. 300 m.w., 0^{15} am., 30 min. 1 ♀ juv. — **St. 161.** 2-8-1910. Surface (P. 100), 3^{10} am., 10 min. 1 ♂ 5 mm. — **St. 161.** ibid. 25 m.w., 3^{00} am., 30 min. 1 ♀ 4 mm. — **St. 221.** 4-9-1910, (P. 100) Surface, 6^{40} pm., 10 min. 1 ♀ 4 mm. — **St. 224.** 5-9-1910. Surface (P. 100), 7^{25} pm., 10 min. 1 ♀ 3 mm, 1 ♂ juv. — **St. 225.** 6-9-1910. Surface (P. 100), 3^{35} am., 10 min. 1 ♂ juv. 3 mm. — **St. 276.** 36°30′ N, 19°20′ E. 4-4-1911. 132 m.w. (S. 200), 11^{20} pm., 35 min. 5 ♂ (2 spec. juv. 4 mm, 3 spec. adult 4—5 mm), 12 ♀ (2 spec. 3 mm, 10 spec. 4—5 mm incl. 2 (1 ?) with embryos 5 mm). — **St. 277.** 33°20′ N, 27°30′ E. 6-4-1911. 132 m.w. (S. 200). 11^{00} pm., 35 min. 2 ♂ juv. 4 mm, 2 ♂ adult 4—5 mm, 7 ♀ 3—4 mm. — **St. 297.** 33°10′N, 25°35′ E. 25-6-1911. 28 m.w. (S. 200), 11^{30} pm., 30 min. 2 ♀ 3—4 mm. — **St. 298.** 34°20′ N, 21°10′ E. 26-6-1911. 38 m.w. (S. 200). 11^{30} pm., 30 min. 3 ♀ 4 mm. — **St. 384.** 32°50′ N, 27°10′ E. 7-7-1911. 122 m.w. (S. 150), 8^{30} pm. 30 min. 1 ♀ 3 mm. — **St. 698.** 37°20′ N, 9°25′ E. 25-2-1913. 5^{00} am. 11 ♂ (2 jun. 3—4 mm, 9 adult 4—5 mm), 11 ♀ (2 spec. 3 mm, 9 spec. 4—5 mm; 3 of them with ova 4 mm).

Mediterranean.

Material and occurrence. All the specimens from the "Thor"-Expedition were taken in the Mediterranean. There are 89 specimens (33 ♂, 51 ♀, 5 spec. juv.) from 15 stations, 22 hauls. The depths of the sea are as a rule 1000—> 3000 m. It occurs fairly evenly distributed in the two basins, but generally keeps to the south side (see Chart 11).

Vertical occurrence. The species keeps near the surface; on an average 10—65 m. w.; no specimens were taken with a greater length of line than 300 m. w., and only a few were taken in each haul.

Propagation. ♂ and ♀ seem to be the same size viz. 5 mm. ♀ with ova or embryos were found in Feb., April and June, i. e. during both winter and summer.

Distribution. Mediterranean: 36°20′ N, 4°30′ W (BOVALLIUS 1889). — Messina (SENNA 1906). — Atlantic: 17°22′ N, 37°23′ W (BOVALLIUS 1889).

3. Genus Hyperia Latr.

Hyperia K. Stephensen 1923, p. 15.

1. HYPERIA MEDUSARUM O. Fr. Müll.

Hyperia medusarum K. Stephensen 1923, p. 15 (lit. and syn.).

Atlantic.

St. 71. 1985 m. 57°47′ N, 11°33′ W. 7-6-1905. 1500 m.w. 10^{00} am., 60 min. 1 ♀ with ova and embryos, 11 mm. — St. 178. 4000 m. 48°04′ N, 12°40′ W. 2-9-1906. 1800 m.w. 9^{05} am., 120 min. 1 ♂ juv. 13 mm.

In my list of synonyms l. c. 1923 I have included *H. hystrix* Bovall., which as far as I have been able to see has not been found since it was established.

In the Hyperine-Magazine of the Copenhagen Zoological Museum I have found 2 (undetermined) specimens from the Japanese Sea (39° N, 133° E, Capt. Andréa 1869), and on comparing these with the Monograph of Bovallius and his locality I have determined them as belonging to his type-specimens of *H. hystrix* (his other type-specimens are said to belong to the Stockholm Museum and have been taken south west of Kamchatka 46° N, 165° E). The two specimens are males, 13(?)—16 mm; the large one is fairly complete, whereas the small specimen, besides the urus lacks all the left-hand pereiopoda, and on comparing them with the figures of Bovallius there is hardly any doubt that the limbs delineated by him were dissected from this very specimen, as p. 1—p. 2 coincide entirely with his statement to the effect that as contrasted with the very closely related *H. medusarum* "dactylus is long, protruding from the bristles" on metacarpus. The difference between the two "species", however, (according to the material of the Zoological Museum, including the types of *H. hystrix*) is not so much due to the fact that the dactylus is particularly long in *H. hystrix*, but to the bristles on metacarpus being considerably longer on *H. medusarum*, so that the dactylus is nearly hidden, whereas it protrudes very much on *H. hystrix*. If Bovallius had examined the large specimen he would have seen that as regards p. 1 (p. 2 is as in the small specimen) this specimen occupies an intermediate position between the two "species".

Both the "Thor"-specimens belong to the form *H. hystrix*, the male, however, not so typical as the female.

Biology. Extremely little is known (see Tesch 1911, p. 179).

Vertical occurrence. The depth below surface at which the species occurs seems to vary between very wide limits; the greater part of the specimens from the British Isles, however, were taken with 200—1800 m. w. (Tattersall and the "Thor"), at the surface it evidently occurs very rarely.

Distribution. Northern Atlantic and Pacific (see my paper l. c. 1923, p. 15, with chart); see also above.

2. HYPERIA GALBA Mont. (Chart 11, p. 80).

Hyperia galba K. Stephensen 1923, p. 17 (lit.).

This species is possibly synonymous with *Hyperia spinigera* Bovallius 1889, p. 191, Pl. 10 figs. 33—39. — *H. s.* Vosseler, 1901, p. 58. — *H. galba* (partim) Norman 1900, p. 128. — *H. spinigera* Tattersall 1906, p. 22 (with remarks on literature). — ?*H. Gaudichaudii* Milne-Edwards (teste Walker 1904, p. 235).

Atlantic.

St. 81. 51°32′ N, 12°03′ W. 14-6-1905. 200 m.w. (Y. 330), 2^{20} am., 120 min. 2 ♀ 13—18 mm. — St. 82. 51°00′ N, 11°43′ W. 15-6-1905. 800 m.w. (Y. 330). 3^{45} pm. 120 min. 1 ♀ 6 mm. — St. 82. ibid. 1200 m.w. 0^{45} pm., 120 min. 1 ♀ 8 mm. — St. 88. 48°09′ N, 8°30′ W. 20-6-1905. 300 m.w., 8^{45} pm., 120 min. 9 spec.: 1 ♂ jun. 9 mm, 1 ♀ with ova 19 mm, 2 ♀ with ova 13 mm, 5 ♀ 7—9 mm. — St. 92. 48°53′ N, 12°21′ W. 24-6-1905. 500 m.w. (Y. 330), 7^{30} am., 60 min. 5 spec.: 3 (1 ?) ♀ with ova 17 mm, 2 ♀ 13—14 mm. — St. 167. 57°46′ N, 9°55′ W. 1-9-1905. 65 m.w. 4 spec.: 2 ♀ 17 mm, 2 ♂ 15 mm. — St. 167. ibid. 100 m.w. 20 spec.: 5 ♂ 15 mm, 2 ♂ 11 mm, 13 ♀ (1 à 24 mm, 1 à 16 mm, 4 à 15 mm, 2 à 11 mm, 2 à 9 mm; 3 with ova 17 mm). — St. 167. ibid. 1500 mw. 4 spec.: 1 ♂ 13 mm, 1 ♂ jun. 8 mm, 1 ♀ 14 mm, 1 ♀ 10 mm. — St. 168. 58°42′ N, 6°13′ W. 2-9-1905. 65 m.w. 1 ♂ juv. 9 mm. — St. 52. 48°42′ N, 12°20′ W. 21-5-1906. 300 m.w. (Y. 330). 6^{10} am., 120 min. 2 spec.: 1 ♂ jun. 9 mm, 1 ♀ 9 mm. — St. 62. 50°25′ N, 12°44′ W. 5-6-1906. 1500 m.w. (Y. 330). 2^{45} am., 120 min. 6 spec.: 1 ♂ 11 mm, 5 ♀ 6—10 mm. — St. 65. 49°04′ N, 14°52′ W, 6-6-1906. 300 m.w. (Y. 330). 7^{00} am. 120 min. 1 ♂ 11 mm. — St. 74. 49°23′ N, 12°13′ W. 10-6-1906. 200 m.w. (Y. 330). 3^{10} am., 120 min. 5 ♀ 10—13 mm. — St. 74. ibid. 2000 m.w. (Y. 330). 11^{35} am., 60 min., 6 spec.: 1 ♂ 11 mm, 3 ♂ jun. (10, 8, 8 mm), 2 ♂ 8—10 mm. — St. 76. 49°27′ N, 13°33′ W. 12-6-1906. 100 m.w. (Y. 330). 0^{20} am. 120 min. 3 spec.: 1 ♂ jun. 11 mm., 2 ♀ 10—14 mm. — St. 76. ibid. 200 m.w. (Y. 330). 2^{40} am., 120 min. 10 spec.: 1 ♂ 12 mm, 2 ♂ jun. 9—11 mm, 7 ♀ 11—14 mm. — St. 76. ibid. 800 m.w. (Y. 200) 6^{15} pm. 120 min. 1 ♀ 13 mm. — St. 76. ibid. 2800 m.w. (D. 2). 3^{00} pm., 120 min. 9 spec.: 1 ♂ 10 mm, 4 ♂ jun. 6—8 mm, 4 ♀ 6—10 mm. — St. 167. 51°28′ N, 11°50′ W. 26-8-1906. 200 m.w. (Y. 330), 10^{30} am., 120 min. 3 spec. jun. 4—7 mm. — St. 167. ibid. 300 m.w. (Y. 200). 8^{00} am., 120 min. 2 spec.: 1 ♂ 13 mm, 1 ♀ 17 mm. — St. 175. 51°11′ N, 11°41′ W. 30-8-1906. 1050 m.w. (Y. 330). 7^{00} pm., 60 min. 45 spec.: 10 ♂ 13—14 mm, 1 ♂ jun. 11 mm, 1 ♀ with embryos 17 mm, 4 ♀ with ova 14—17 mm, 28 ♀ 12—18 mm, 1 ♀ 9 mm. — St. 176. 49°31′ N, 11°51′ W. 31-8-1906. 300 m.w. (Y. 330), 9^{30} pm., 120 min. 70 spec.: 6 ♂ 12—13 mm, 1 ♂ jun. 11 mm, 8 ♀ with embryos 12—16 mm, 37 ♀ with ova 12—17 mm, 4 ♀ without ova 11—12 mm, 14 ♀ 13—18 mm. — St. 178. 48°04′ N, 12°40′ W. 2-9-1906. 1000 m.w. (Y. 330), 7^{05} am., 60 min. 1 ♀ 6 mm. — St. 178. ibid. 1800 m.w. (Y. 330). 9^{05} am., 120 min. Abt. 700 spec.: 4 ♂ 12—13 mm, 4 ♂ jun. 12 mm, 1 ♂ jun. 11 mm, 6 ♂ jun. 10 mm, 18 ♂ jun. 7.5—9 mm. — 5 ♀ with ova 11—12 mm, 5 ♀ with ova 14 mm, 63 ♀ without ova (1:17 mm, 3:16 mm, 2:15 mm, 8:14 mm, 6:13 mm, 1:12 mm, 42:7—11 mm). ca. 600 spec. jun. 4—8 mm. — St. 179. 47°20′ N, 13°20′ W. 3-9-1906. 1800 m.w. (Y. 330). 3^{40} am., 120 min. abt. 250 spec.: 3 ♂

12—13 mm, 2 ♂ jun. 11 mm, 2 ♂ jun. 10 mm, 2 ♂ jun. 9 mm, 6 ♂ jun. 8 mm, 5 ♂ jun. 7 mm, 21 ♂ jun. 5—6 mm, 3 ♂ jun. 4 mm. — 2 ♀ with ova or embryos 14 mm, 6 do. 13 mm, 2 do. 12 mm, 2 do. 11 mm. 1 ♀ without ova 17 mm, 3 ♀ 14 mm, 4 ♀ 13 mm, 4 ♀ 12 mm, 3 ♀ 10 mm, 4 ♀ 9 mm, 4 ♀ 8 mm, 12 ♀ 7 mm, 12 ♀ 6 mm, 2 ♀ 4.5—5 mm. 160 spec. juv. 3.5—7 mm. — **St. 180.** 48°19′ N, 13°53′ W. 3-9-1906. 1800 m.w. (Y. 330). 5^{05} pm. 60 min. abt. 360 spec.: 1 ♂ 11 mm, 1 ♂ jun. 12 mm, 2 ♂ jun. 11 mm, 5 ♂ jun. 10 mm, 2 ♂ jun. 9 mm, 17 ♂ jun. 7—8 mm. — 2 ♀ with ova 16 mm, 1 do. 14 mm, 3 do. 13 mm, 2 do. (1 with embryos) 12 mm, 2 do. 11 mm, 3 do. 10 mm. — 1 ♀ without ova 17 mm, 3 ♀ 15 mm, 1 ♀ 14 mm, 7 ♀ 13 mm, 4 ♀ 11—12 mm, 1 ♀ 10 mm, 5 ♀ 9 mm, 4 ♀ 8 mm. — abt. 300 spec. jun. 4—7 mm. — **St. 181.** 49°22′ N, 12°52′ W. 4-9-1906. 1800 m.w. (Y. 330). 10^{35} am. 60 min. Abt. 350 spec.: 4 ♂: 14,12,11,10 mm, 8 ♂ jun. 7—9 mm; 1 ♀ with ova 17 mm, 1 do. 16 mm, 3 do. 15 mm, 3 do. 14 mm, 3 do. 13 mm, 1 do. 12 mm, 1 do. 11 mm, 3 ♀ with embryos 13—15 mm; 1 ♀ without ova or embryos 20 mm, 1 ♀ 17 mm, 2 ♀ 15 mm, 1 ♀ 14 mm, 1 ♀ 13 mm, 3 ♀ 12 mm, 7 ♀ 10—11 mm, 5 ♀ 8—9 mm; abt. 300 spec. jun. 3.5—7 mm. — **St. 3.** 30-11-1908. 65 m.w. (Y. 200). 1^{15} pm., 30 min. 1 juv. 3 mm. — **St. 75.** 9-3-1909. 25 m.w. (Y. 200). 10^{15} pm., 30 min. 5 spec.: 1 ♀ with embryos 21 mm, 1 ♀ 16 mm, 1 ♀ with ova 14 mm, 2 ♂ jun. 8 mm. — **St. 75.** ibid. 300 m.w. (Y. 200). 7^{45} pm., 60 min. 2 spec.: 1 ♀ 20 mm, 1 ♂ juv. 13 mm. — **St. 75.** ibid. 600 m.w. 6^{30} pm., 60 min. 1 ♀ 14 mm. — **St. 76.** 10-8-1909. 65 m.w. 6^{05} pm., 60 min. 2 ♀ with ova 17—18 min. — **St. 76.** ibid. 1600 m.w. 2^{40} pm., 60 min. 1 ♀ 13 mm. — **St. 249.** 21-9-1910. Surf. (P. 100). 11^{55} pm., 10 min. 17 spec.: 8 ♂ 10—11 mm, 5 ♂ 8—9 mm, 2 ♂ jun. 5 mm, 2 ♂ juv. 4 mm. — **St. 265.** 39°22′ N, 22°49′ W. 20-3 1911. 25 m.w. (S. 150), 7^{00} pm., 30 min. 4 spec.: 1 ♀ 16 mm, 3 ♂ jun. 6—7 mm. — **St. 266.** 40°47′ N. 21°10′ W. 21-3-1911. 25 m.w. (S. 150), 7^{00} pm., 30 min. 17 spec.: 2 ♂ 12 mm, 1 ♂ 11 mm, 4 ♂ jun. 7—11 mm; 1 ♀ 14 mm, 4 ♀ 10 mm, 3 ♀ 7—8 mm, 2 spec. jun. (♀?). 4—5 mm. — **St. 266.** ibid. 47 m.w. (S. 100), 7^{00} pm., 30 min. 1 spec. jun. 5 mm. — **St. 267.** 42°37′ N, 18°06′ W. 22-3-1911. 25 m.w. (S. 150), 7^{00} pm., 30 min. 8 spec.: 2 ♂ 14—15 mm, 5 ♀ 12—15 mm, 1 spec. jun. 5 mm. — **St. 269.** 46°44′ N. 11°20′ W. 24-3-1911. 25 m.w. (S. 150). 7^{30} pm., 30 min. 13 spec.: 1 ♂ 15 mm, 2 ♂ jun. 9—12 mm; 1 ♀ with ova 17 mm, 1 ♀ 19 mm, 1 ♀ 17 mm, 2 ♀ 15 mm, 1 ♀ 13 mm, 3 ♀ 10 mm, 1 (♀?) jun. 5 mm. — **St. 270.** 47°01′ N, 19°03′ W. 13-2-1911. 116 m.w. (S. 150), 10^{05} pm., 33 min. 2 ♀ 11—20 mm.

All ♂ are full-grown when not designated as juv.

As regards the synonymy I follow G. O. Sars (1895) as also done by Tattersall (1906) (Walker [l. c.] is inclined also to include *H. Gaudichaudii*).

On the other hand, I have my doubts as to *H. spinigera* Bovall. (for previous writers see Tattersall 1906); but I may say at once that in the collections of the "Thor" there is not a single specimen which can be ascribed to *H. spinigera*.

Bovallius states (Monograph) that he has borrowed specimens of *H. spinigera* from the Copenhagen Museum among others. We have no specimens determined with this name, whereas there are six tubes with "*Hyperia spinosa*", determined by Bovallius. As there is no species of this name in extant literature, and as the specimens, at any rate as far as the most important character is concerned, fit in with the description of *H. spinigera*, there can be no doubt that we have here the types of Bovallius, or at any rate specimens of the species dealt with. That the name does not correspond in this context signifies nothing, as Bovallius has not carried through the labelling of the material borrowed from Copenhagen. This material has the following localities: North side of Iceland, Borch ded. 1859, 1 ♂ 17 mm; 61° N, 20° W, Olrik ded. 1867, 1 ♂ 19 mm; 57°25′ N, 47°12′ W, Olrik ded. 1867, 2 ♂ 18—19 mm; 42° N, 49° W, Andréa ded. 1862, 1 ♂ 19 mm (?, defective), 2 ♂ 17—18 mm; 18° S, 2° W, Andréa ded. 1864, 1 ♂ 18 mm; 33°20′ S, 33° 0′ E, Andréa ded. 1869, 1 ♂ 16 mm.

As regards p. 1—p. 2, Bovallius' specimens fit in well on the whole with his description; but in all specimens the 3. epimeral plate occupies an intermediate position between *H. galba* and *H. spinigera*. Tattersall says (l. c.) of 3. epimeral plate: "in *H. galba* the postero-lateral angles of these epimera are sharply pointed, while in *H. spinigera* they are rounded". If "they" only refers to the points themselves, not to the whole of the epimeral plate, the description of Tattersall agrees very well with the majority of Bovallius' specimens.

As, apart from the characters emphasized the agreement with *H. galba* is very marked, I am, as long as there is no more material at our disposal, inclined to follow the supposition of Norman that *H. spinigera* was established from old specimens of *H. galba*, for in the specimens mentioned in the literature the size, when indicated at all, is very considerable: 12—22 mm (Bovallius, Monograph), 16—19.5 mm (Bovallius' spec. in the Copenhagen Zool. Mus.), 18.5 mm (Vosseler). Curiously enough, all the specimens known seem to be ♂, with the exception of the ♀ mentioned by Norman from Birturbuy Bay and Valentia. —

The material is extremely large, comprising about 2000 specimens (202 ♂, 413 ♀, about 1350 spec. juv.), distributed among 27 stations, 40 hauls. Unfortunately, nearly the whole of the material dates from 1905—06, for which reason it cannot be used for quantitative investigations, as possibly parts of the collections from these years have not been preserved.

Occurrence (see Chart 11, p. 80). Nearly all of the specimens have been taken round the British Isles, in particular off S.W. Ireland.

The depths of the sea are on an average very great, 1000—6020 m, but a few specimens have been taken at lower depths (110—130 m). That the "Thor" took it at

depths much greater than usual, must presumably be due to the fact that the "Thor", particularly in these waters, carried on its investigations at depths exceeding 500—1000 m.

Vertical occurrence. The majority of specimens were taken with a great length of wire, 300—2000 m.w. and a few of the deep water hauls yielded very large quantities indeed (shoals): St. 178 (1906), 1800 m. w.: 700 spec.; St. 179 (1906), 1800 m. w.: 250 spec.; St. 180 (1906), 1800 m. w., 360 spec.; St. 181 (1906), 1800 m.w. 350 spec.

Propagation &c. The material contains nearly twice as many ♀ (413) as ♂ (202), but a still greater number of specimens too young for sex determination. ♂ are on an average 11—12 (14) mm long; ♀ considerably larger, 12—20 mm, a single specimen of even 24 mm (St. 167, 1905). ♀ with ova are as a rule (11)12—17(19, 21) mm long. ♀ with ova or embryos have been found in March and June, but particularly in Aug.—Sept. and young specimens, too small for sex determination (< about 7 mm) during the same months, but more particularly in September, which thus shows that the spawning takes place chiefly during the summer and early autumn. As the ♀ with ova are not always the largest individuals in each haul, it seems that they do not die as soon as the young ones have left the marsupium of the mother. The sizes are larger than those given by Sars: ♂ 12 mm, ♀ 14 mm; a single specimen even as large as indicated in the case of Arctic individuals (24 mm).

All the "Thor" specimens seem to have been taken freely; as for the Medusæ in which the species may live see Tattersall, 1906, and Tesch 1911, p. 178.

Distribution.

1. Mediterranean. Bovallius (l. c. p. 164, *H. Latreillei*) states that it was taken in the Mediterranean, but without indicating the locality.

2. Atlantic (*H. galba*). The whole of the Arctic and northern part of the Atlantic, especially in the eastern region, and within the latter it is most frequently found off the British coasts, where it must be said to belong to the Plankton character forms. Towards the north it has not been found at such great depths as south and west of Ireland. South of this area, it is, as far as I can see, only noted from the Azores (Chevreux, 1900) and Madeira (Stewart 1913, p. 255). For a complete list of localities in Northern Atlantic see my paper l. c. 1923, p. 17, with chart.

H. spinigera is found in the following places, the specimens determined by Bovallius being mentioned above with their localities (p. 82). Bovallius specifies the distribution in the following manner: "The Arctic Region: Spitzbergen, off the Northern coast of Norway. The Northern temperate region: off the South coast of England." None of the above-mentioned specimens, determined by himself, are thus included in his own list of localities. — Birturbuy Bay and Valentia Harbour (Norman 1900). W. Ireland (Tattersall 1906). The Labrador Current 50° N, 48.1° W, surf., 1 ♂ 18.5 mm. (Vosseler 1901).

3. Indian Ocean. Close to the east of the south point of Africa; *H. spinigera* (see above); Galle (Gulf of Manaar, Ceylon; Walker 1904, p. 235 [*H. galba*]).

4. Northern Pacific at Puget Sound (*H. galba*) (Calman, *teste* Tattersall (1906)).

3. HYPERIA FABREI M.-Edw.

Lestrigonus Fabrei Milne-Edwards, Ann. Sci. Nat., vol. 20, 1830, p. 392. — **Hyperia Fabrei* Bovallius 1889, p. 206 (lit.), Pl. 10 figs. 40—53. — **H. F.* Vosseler 1901, p. 58, Pl. 5 figs. 5—15. — *H. Vosseleri* Stebbing 1904, p. 33—34.

Atlantic.

St. 376. 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w., (S. 200). 8^{15} am. 1 ♀ 3 mm. — **St. 377.** 31°23′ N, 18°08′ W. 24-7-1911. 15 m.w. (S. 200). 8^{05} pm. 1 ♀ 3 mm.

I cannot see that Stebbing is right in distinguishing the species of the later authors from the one determined by Milne-Edwards, only because of the difference in size (M.-Edw.: "long d'environ cinq lignes" = 10.5 mm, other authors: 3—6 mm).

Distribution. [Mediterranean. Is probably not known from this area, at all events not taken by the "Thor". Lo Bianco (1903—04, p. 238) gives it from Capri, but in his list of stations (l. c. p. 127, St. 17) it is marked with ?, and the same applies to Vosseler in his more detailed table (ibid. p. 278).]

1. Atlantic. Bovallius gives (Monograph) the distribution as tropical regions of Atlantic: Barbados, Caribbean Sea.

Vosseler (1901) mentions 71 spec. from 41 stations: Florida Current 4 st. 41.6° N, 56.3° W to 37.1° N, 59.9° W, 0—200 or 0 m. Sargasso Sea 6 st. 34.7° N, 62.4° W to 25.6° N, 34.9° W, and 27.8° N, 33° W; 0—200 (0—400) m. N. Equatorial Current 11 st. 28.3° N, 34.3° W, to 10.2° N, 22.2° W; 18.5° N, 38.1° W, and 20.4° N, 37.8° W; 0—200 m (or 0, 0—400, 0—1000 m). Guinea Current 3 st. 5.9° N, 20.3° W, to 2.9° N, 18.4° W, 0—400 m. S. Equatorial Current 17 st. 1.7° N, 17.3° W, to 5.1° S, 14.2° W; 6.8° S, 14.2° W; 7.5° S, 20.3° W, to 2.4° S, 36.4° W; 0—200 (or 0, 0—400) m.

The species is new to the "Thor"-area.

2. Indian Ocean. Without special locality (Milne-Edwards).

4. HYPERIA LUZONI Stebb. (Fig. 34, chart 12).

**Hyperia Luzoni* Stebbing, 1888, p. 1382, Pl. 166 fig. A, and "young?", p. 1384 (teste Stebbing 1904, p. 33). — *H. L.* Bovallius 1889, p. 212. — **H. L.* Vosseler 1901, p. 64, Pl. 5 figs. 16—28. — *H. L.* Lo Bianco 1902, p. 424, 446. — *H. L.* Stebbing 1904, p. 33. — *H. L.* Vosseler, in Lo Bianco 1903, p. 278.

The "Thor" material contains far more ♂ than ♀, *viz.* 82 ♂ (81 ad., 1 juv.) against only 8 ♀. The adult ♂ is only described by Vosseler;* but his description (l. c.) is so brief that I consider it necessary to supplement it with figures and descriptions of new important characters.

♂ adult. Length 3 mm (fig. 34). Considerably slenderer than ♀; there is a similar sexual difference,

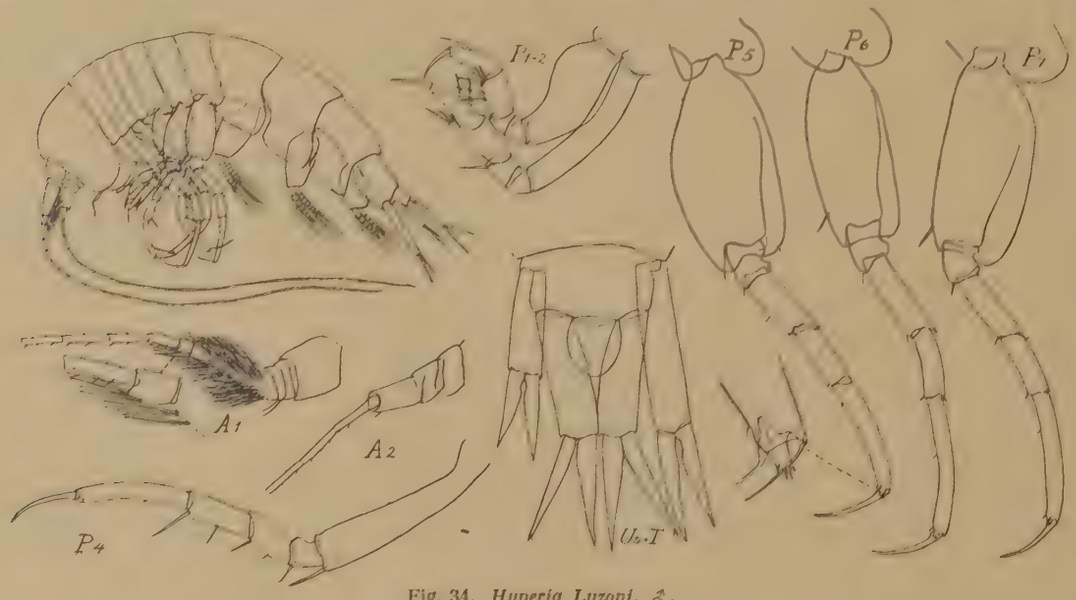

Fig. 34. *Hyperia Luzoni*, ♂.

albeit not quite so marked, to that found in *H. schizogeneios*, the females of the latter species being considerably thicker, particularly in the head, than *H. Luzoni*.

The cephalon is nearly the same length as 1.—4. mesosome segments together, and about $^1/_2$ or $^3/_2$ as deep as the latter. There are no processes on the underside as in *H. schizogeneios*. 1.—2. mesosome-segments are, as far as one can see, entirely fused, except at the lower part of the lateral side, where there is a seam. 1.—4. mesosome segments are more or less of the same length; the following ones increase in length, so that 7. segment is nearly double the length of 4. segment. The metasome segments are about double the length of the posterior mesosome segment. The outline of the epimeral parts of the metasome segments (which are here shown, these parts being dissected separately) deviate slightly from the form of ♀ (Vosseler l. c., fig. 16) and the young ♂

* Miss Stewart (1913) has also seen the adult ♂, but does not describe it.

Mediterranean.

St. 116. 30-6-1910. Surf. (P. 100), 1^{50} am., 10 min. 1 ♂ 2.5 mm. — **St. 129.** 12-7-1910. Surf. (P. 100), 3^{10} am., 10 min. 30 ♂ 2.5—3 mm. — **St. 132.** 14-7-1910. Surf. (P. 100), 1^{10} am., 10 min. 2 ♀ 1.5—2 mm. — **St. 144.** 24-7-1910. Surf. (P. 100), 2^{10} am. 10 min. 1 ♂ 3 mm. — **St. 145.** 25-7-1910. Surf. (P. 100), 3^{40} am., 10 min. 2 ♂ 3 mm. — **St. 154.** 29-7-1910. Surf. (P. 100), 3^{40} am., 10 min. 4 ♂ 3 mm. — **St. 156.** 30-7-1910. Surf. (P. 100), 2^{25} am., 10 min. 4 ♂ 3 mm. — **St. 160.** 1-8-1910. Surf. (P. 100), 2^{10} am., 10 min. 3 ♂ 3 mm. — **St. 161.** 2-8-1910. Surf. (P. 100), 3^{10} am., 10 min. 3 ♂ 3 mm. — **St. 163.** 5-8-1910. Surf. (P. 100), 0^{15} am., 10 min. 2 ♀ 2 mm. — **St. 187.** 18-8-1910. Surf. (P. 100), 7^{50} pm., 10 min. 1 ♀ 2.5 mm. — **St. 194.** 21-8-1910. Surf. (P. 100), 4^{35} am., 10 min. 7 ♂ 3 mm. — **St. 200.** 26-8-1910. Surf. (P. 100), 3^{50} am., 10 min. 9 ♂ 3 mm. — **St. 204.** 27-8-1910. Surf. (P. 100), 4^{35} am., 10 min. 12 ♂ 3 mm, 1 ♀ 2 mm. — **St. 222.** 4-9-1910. Surf. (P. 100), 11^{25} pm., 10 min. 1 ♂ 3 mm. — **St. 281.** 38°13′ N, 15°36.5′ E. 1-3-1911. 40 m.w. (S. 100) 6^{10} pm., 120 min. 1 ♂ 3 mm.

Atlantic.

St. 89. 18-6-1910. Surf. (P. 100), 3^{30} am., 10 min. 3 spec.: 2 ♂ 3 mm, 1 ♀ 2 mm. — **St. 233.** 10-9-1910. Surf. (P. 100), 5^{10} am., 10 min. 1 ♂ 3 mm. — **St. 376.** 31°41′ N, 16°14′ W. 24-7-1911. 15 m.w. (S. 200), 8^{15} pm., 30 min. 1 ♂ jun. 2.5 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. 1 ♀ 2 mm.

(Stebbing l. c. 1888, Pl. 166) 1. segment in particular being practically rectangular, posteriorly not pointed, as shown by those writers. As regards the urosome, there is nothing to remark, but the telson in all the adult males is only half as long as the peduncle in up. 3, whereas in females and the young males it is as a rule $^2/_3$ as long. It is an interesting feature that the telson on the adult ♂ is thus comparatively shorter than on the ♀ and the young ♂, for the same character has formerly been mentioned by Vosseler (l. c.) as applying to *H. Fabrei*. True, Vosseler says (of *H. Fabrei* ♂) that the telson is "halb so long wie das letzte Urussegment, aber kürzer als das Grundglied des dritten Uropoden"; but this must be a printer's error for "das halbe Grundglied", as the whole thing otherwise becomes an impossibility. However, the telson in a few ♀ of my material (*H. Luzoni*) is not longer than in the adult ♂; this holds good of ♀ from St. 132 and the one ♀ from St. 163; in all the others the telson has the normal size depicted by Stebbing for ♂ jun. and by Vosseler for ♀.

Of the two pairs of antennæ, the upper pair are nearly as long as the whole body, and have about 18 joints in the flagellum, whereas the lower pair have about 20 joints in the flagellum and are a little longer. 2. joint of the flagellum in ant. 1. has on the underside of the distal end a process with sensitory hairs, exactly as shown by Chevreux in the adult ♂ of *H. schizogeneios* (see the latter). In p. 1, the second joint is a little heavier than shown by Stebbing (l. c. 1888); on the front margin of metacarpus there is as a rule 1 spine, but in a few cases 2. Metacarpus on p. 2 always seems to have 2 spines on the front margin. P. 3—p. 7 coincide extremely well with Stebbing's figures (l. c. 1888) of the young male with the exception that in the adult they are considerably slenderer, particularly at the distal end. An excellent and striking character of the species (which applies both to ♂ [juv. and ad.] and ♀) is afforded by the two large spines on the hind margin of 5. joint in p. 3—p. 4 in connection with the fact that 2. joint in p. 5—p. 7 is at most half as broad as long; the same spines are, it is true, to be found in *H. Fabrei*, but the pereiopoda are on the whole heavier, and 2. joint on p. 5—p. 7 (in particular in p. 5) is clearly more than half as broad as it is long. The sixth joint in p. 5—p. 7 terminates in a dentate process. The character which in the earlier literature was considered the most important one, the length of the telson in proportion to the peduncle in up. 3, can, according to the above, no longer be used as a specific character for *H. Luzoni*, at any rate not as far as the adult male is concerned.

The uropoda deviate from Stebbing's description of the young male in the following respects: the peduncle in up. 2 slightly longer (not shorter) than the inner ramus, and the rami in up. 3 extend as far posteriorly as the rami in up. 1. The rami in up. 1—up. 2 have at the proximal end of the median margin an excavation like the males of several of the other species; an excavation of this kind is hardly indicated in up. 3.

Chart 12. *Hyperia Luzoni* (St. 376 and 399 lie outside the map to the S.W.).

Material. As mentioned above, the material in all contains 90 spec. (82 ♂, 8 ♀) of which by far the greater number *viz.* 84 spec. (78 ♂, 6 ♀) are from the Mediterranean.

A. Mediterranean. The species was taken at 16 stations and practically only at depths > 1000 m, in several places even at depths > 3000 m. It seems to be fairly evenly distributed over the eastern and western basin, and even penetrates into the Ægean Sea, but appears to be limited to the region South of about 40° N. It was formerly only known from 3 localities at Capri, and only in 6 spec. in all (2 ♀: Lo Bianco 1901 [1902]; 1 ♂ ad., 3 ♀ ad. [1 locality]: Vosseler in Lo Bianco 1903; 10—11 am., 2000 m. w., 2000 m).

Vertical occurrence. All specimens were taken during the night close to the surface; only very rarely were they taken with 40 m.w. Where they live during the day, it is consequently not possible to say; but the

two Lo Bianco specimens mentioned above were taken during the forenoon with 1500 and 500 m. w.

Other biological data cannot be given on the strength of the "Thor" material.

B. Atlantic. The "Thor" (and "Florida") have taken it at 4 stations in the Bay of Cadiz and west of that; the conditions under which it was caught were exactly like those in the Mediterranean.

Distribution. 1. Mediterranean (see above).

2. Atlantic. The most northerly locality known to me is the Bay of Biscay, 100—0 fms., 1 female with ova (Stebbing l. c. 1904), but this is clearly only an isolated find north of the northern limit proper. Vosseler (1901) mentions 22 spec. from 15 hauls about 39°—0° N, 14°—50° W, i. e. the Gulf Stream 39.1° N, 23.5° W, 0—400 m, Sargasso Sea 30.9° N, 50° W, 0—400 m, and 27.8° N, 33° W, 0—200 m. N. Equatorial Current 6 st. 28.9° N, 35° W, to 24.6° N, 31° W; and 10.2° N, 22.2° W; 0—400 m. Guinea Current 4 st.: 7.9° N, 21.4° W to 5.3° N, 19.9° W, 0—200 m, and 9.4° N, 41.9° W, 0—400 m. S. Equatorial Current 2 st. 0.1° N, 15.2° W and 5.1° N, 14.1° W, 0—200 m. — From the Atlantic S. of Equator Miss Stewart (1913) mentions it from near Bahia, 13°59′ S, 34°35′ W, 1 spec., and N. of Tristan da Cunha 28°25′ S, 23°56′ W, 1 spec.

3. Pacific. Stebbing ("Challenger") has it from the following localities: China Sea, off Luzon 16°35′ N, 117°47′ E, surf. 1 ♂ jun.; Zulu Harbour, Philippines, surf., 2 spec., and southern Pacific, 38°6′ S, 88°2′ W, surf. 1 spec. Miss Stewart (1913) mentions it from S. of New Zealand 56°30′ S, 169°30′ E.

5. HYPERIA SCHIZOGENEIOS Stebb. (Chart 13).

**Hyperia schizogeneios* Stebbing 1888, p. 1391, Pl. 168. — *H. s.* Bovallius 1889, p. 221. — **H. s.* Chevreux, Sur le mâle adulte d'Hyperia schizogeneios Stebb.; Bull. Soc. Zool. France vol. 17, 1892, p. 233, 3 textfigs. — **H. s.* Chevreux 1900, p. 139, Pl. 16 fig. 1. — *H. s.* Vosseler 1901, p. 66. — *Lestrigonus mediterraneus* A. Costa, Sopra une Specie Mediterranea del Genre Lestrigonus; Rendiconto dell' Acc. Sci. Fis. e Math., Anno 4, 1865, p. 34 (teste Chevreux 1900). — *H. mediterranea* Bovallius 1889, p. 240. — **H. promontorii* Stebbing 1888, p. 1385, Pl. 166 fig. B. — *H. p.* Bovallius 1889, p. 214, Pl. 11 figs. 3—13. — *H. p.* Vosseler 1901 p. 64. — *H. p.* + *H. schizog.* Vosseler, in Lo-Bianco 1903, p. 278.

Mediterranean.

St. 106. 25-6-1910. 0^{20} am. Surf. (P. 100), 10 min. 1 spec. jun. 1.5 mm. — **St. 107.** 25-6-1910. 7^{30} am. 2000 m.w., 60 min. 1 ♂ ad. 4 mm, 2 spec. jun. 1.5 mm. — **St. 108.** 25-6-1910. Surf. (P. 100), 10^{40} pm, 10 min. 5 spec.: 2 ♂ jun. 2.5—3 mm, 1 ♀ 3 mm (2 spec. jun. 1.5 mm?). — **St. 112.** 27-6-1910. Surf. (P. 100), 0^{20} am,, 10 min. 29 spec.: 10 ♂ (adult?) 3 mm, 5 ♂ jun. 2—3 mm, 4 ♀ (jun.?) 2 mm, 10 spec. jun. 1—2 mm. — **St. 113.** 28-6-1910. Surf. (P. 100), 3^{30} am., 10 min. 14 spec.: 12 ♂ adult 4 mm, 1 ♀ 2.5 mm, 1 jun.? 1.5 mm. — **St. 115.** 28-6-1910. Surf. (P. 100), 11^{30} pm., 10 min. 5 spec.: 2 ♂ adult 4 mm, 2 ♀ 2—3 mm; 1 ♀ with ova 3 mm. — **St. 116.** 30-6-1910. Surf. (P. 100) 1^{50} am., 10 min. 4 ♂ adult 4 mm, 4 ♂ jun. 2—3 mm. — **St. 116.** ibid. 25 m.w., 3^{00} am., 15 min. 1 ♂ adult 3 mm. — **St. 118.** 30-6-1910. Surf. (P. 100), 11^{05} pm., 10 min. 5 spec.: 2 ♂ adult 3 mm, 1 ♂ jun. 3 mm, 2 ♀ 2—2.5 mm. — **St. 118.** ibid. 1-7-1910. 25 m.w., 0^{20} am., 15 min. 1 ♂ adult 4 mm. — ? **St. 123.** 3-7-1910. Surf. (P. 100), 1^{05} am., 10 min. 1 ♂ adult 4 mm. — **St. 125.** 9-7-1910. Surf. (P. 100), 10^{40} pm., 10 min. 1 ♀ 3 mm. — **St. 126.** 10-7-1910. Surf. (P. 100), 10^{20} pm., 10 min. 1 ♀ 3 min. — **St. 129.** 12-7-1910. Surf. (P. 100), 3^{10} am., 10 min. 12 spec.: 5 ♂ adult 3 mm, 1 ♂ jun. 2 mm, 6 ♀ 2 mm. — ? **St. 129.** ibid. 1000 m.w., 4^{20} am., 60 min. 1 ♂ adult 4 mm. — **St. 132.** 14-7-1910. Surf. (P. 100), 1^{10} am., 10 min. 5 spec. jun. 1—2 mm. — **St. 136.** 19-7-1910. 25 m.w., 30 min., 3^{10} am. 1 ♂ 4 mm. — **St. 138.** 19-7-1910. 1000 m.w., 7^{40} pm., 60 min. 1 ♂ 3 mm. — **St. 139.** 20-7-1910. Surf. (P. 100), 2^{00} am., 10 min. 1 ♂ 4 mm, 1 ♀ 2.5 mm, 1 jun. 1 mm. — **St. 139.** ibid. 25 m.w., 1^{40} am., 30 min. 1 ♂ 4 mm, 1 ♂ 3 mm.

St. 141. 20-7-1910. Surf. (P. 100), 10^{40} pm., 10 min. 3 ♂ (2 adult, 1. jun). 3—4 mm. 1 ♀ 2 mm. — **St. 143.** 23-7-1910. Surf. (P. 100), 0^{40} am., 10 min. 9 ♂ 4 mm. — ? **St. 144.** 24-7-1910. Surf. (P. 100), 2^{10} am., 10 min. 1 ♂ 3 mm. — ? **St. 161.** 2-8-1910. Surf. (P. 100), 3^{10} am., 10 min. 3 ♂ jun., 3 mm. — **St. 163.** 5-8-1910. Surf. (P. 100), 0^{15} am., 10 min. 6 ♂ 4 mm. — ? **St. 185.** 17-8-1910. 11^{10} am., surf. (P. 100), 10 min. 2 ♀ 2—3 mm. 1 jun. 1 mm. — **St. 186.** 17-8-1910. Surf. (P. 100), 11^{30} pm., 10 min. 1 ♂ 5 mm. — **St. 187.** 18-8-1910. Surf. (P. 100), 7^{50} pm., 10 min. 4 ♀ 1—3 mm. — **St. 197.** 24-8-1910. Surf. (P. 100). 7^{10} pm., 10 min. 1 ♂ 3.5 mm. — **St. 199.** 25-8-1910. Surf. (P. 100), 9^{30} pm., 10 min. 1 ♂ jun. 3 mm. — **St. 204.** 27-8-1910. Surf. (P. 100), 4^{35} am., 10 min. 1 ♂ 3.5 mm. — **St. 205.** 27-8-1910. Surf. (P. 100). 7^{40} pm., 10 min. 130 spec.: 100 ♂ 3—4 mm, 20 ♂ jun. 3 mm, 10 (♀?) jun. 1 mm. — **St. 206.** 28-8-1910. Surf. (P. 100), 1^{10} am., 10 min. 120 ♂, 3—4 mm. — **St. 206.** ibid. 1000 m.w. (Y. 200), 1^{40} am., 45 min. 1 ♂ 4 mm. — **St. 207.** 28-8-1910. Surf. (P. 100), 8^{45} pm., 10 min. 1 ♂, 4 mm. — **St. 208.** 29-8-1910. Surf. (P. 100), 1^{45} am., 10 min., 12 spec.: 4 ♂ 3 mm, 1 ♂ jun. 2 mm, 7 ♀ 2 mm. — **St. 209.** 29-8-1910. Surf. (P. 100), 5^{00} am., 10 min. 12 spec.: 2 ♂ 3 mm, 2 ♂ jun. 2.5 mm, 8 ♀ (1 with ova 3 mm) 2—3 mm. — **St. 210.** 30-8-1910. Surf. (P. 100), 2^{50} am., 10 min. 18 ♂ 3—4 mm. — **St. 210.** ibid. 25 m.w. (Y. 200), 30 min., 2^{45} am. 1 ♂ jun. 3 mm. — **St. 218.** 2-9-1910. Surf. (P. 100), 2^{10} am., 10 min. 16 spec.: 10 ♂ 3 mm, 6 ♀ 1.5 mm. — **St. 220.** 4-9-1910. Surf. (P. 100), 2^{20} am., 10 min. 11 spec.: 8 ♂ 3 mm, 3 ♀ 1.5—3 mm. — **St. 222.** 4-9-1910. Surf. (P. 100), 11^{25} pm., 10 min. 10 spec.: 5 ♂ 3 mm, 1 ♂ jun. 3 mm, 4 ♀ 2 mm. — **St. 223.** 5-9-1910. Surf. (P. 100), 4^{40} am., 10 min. 24 spec.: 10 ♂ 3—4 mm, 4 ♂ jun. 2—3 mm, 10 ♀ 2 mm (1 with ova). — **St. 224.** 5-9-1910. Surf. (P. 100), 7^{25} pm., 10 min. Abt. 100 spec.: 24 ♂ 3—4 mm, 15 ♂ jun. (1)2—4 mm, abt. 65 ♀ 1—3 mm. — **St. 225.** 6-9-1910. Surf. (P. 100), 3^{35} am., 10 min. 4 spec.: 1 ♂ 3 mm, 2 ♂ jun. 2 mm, 1 ♀ 2 mm. — **St. 227.** 6-9-1910. Surf. (P. 100), 5^{40} pm.,

10 min. 1 spec. jun. 1 mm. — **St. 228.** 7-9-1910. Surf. (P. 100), 2^{00} am., 10 min. 3 spec.: 2 ♂ 3 mm, 1 ♂ jun. 3 mm. — **St. 280.** 25-2-1911. 15 m.w. (S. 100), 5^{20} pm., 120 min. 2 spec.: 1 ♂ 4 mm, 1 ♀ 3 mm. — **St. 281.** 1-3-1911. 10 m.w. (S. 100), 4^{55} pm., 120 min. 3 ♂ 5 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 7^{50} pm., 120 min. 6 spec.: 2 ♂ jun. 2—3 mm, 4 ♀ 2 mm. — **St. 281.** 5—8 m. 1-3-1911. 30 m.w. (S. 100), 3^{45} pm., 120 min. 1 ♀ 2 mm. — **St. 282.** 8-3-1911. 40 m.w. (S. 100), 7^{15} pm., 90 min. 3 spec.: 1 ♂ jun. 3 mm, 2 ♀ 2 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 9^{00} pm., 90 min. 1 ♀ 2 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 2^{00} am., 60 min. 3 spec.: 2 ♂ 4 mm, 1 ♀ 2.5 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 10^{45} pm., 180 min. 1 ♀ 3 mm. — **St. 283.** ibid. 12-3-1911. 40 m.w. (S. 100), 6^{30} pm., 180 min. 1 ♀ with embryos, 2 mm. — **St. 339.** 40°30′ N, 3°10′ E. 20-8-1911. 28 m.w. (S. 150), 3^{00} am., 30 min. 5 ♂ 4 mm. — **St. 340.** 35°50′ N, 21°30′ E. 26-8-1911. 28 m.w. (S. 200), 9^{00} pm., 30 min. 1 ♂ 5 mm. — **St. 340.** ibid. 108 m.w. (S. 150), 9^{00} pm., 30 min. 3 spec.: 2 ♂ 4—5 mm; 1 ♀ 2 mm. — **St. 341.** 34°00′ N, 26°20′ E. 27-8-1911. 28 m.w. (S. 200), 11^{00} pm., 30 min. 2 ♂ 5 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 8 spec.: 4 ♂ 3—4 mm, 1 ♂ jun. 3 mm, 3 ♀ 3 mm. — **St. 410.** 37°12′ N, 1°18′ W. 29-12-1911. 112 m.w. (S. 150), 7^{00} pm., 30 min. 21 spec.: 3 ♂ jun. 2—3 mm, 18 ♀ 3 mm. — **St. 697.** 36°05′ N, 4°40′ W. 22-2-1913. 5^{00} am. 1 ♂ 3 mm. — **St. 698.** 37°20′ N, 9°25′ E. 25-2-1913. 5^{00} am. 11 spec.: 9 ♂ 4 mm, 2 ♀ 3 mm. — **St. 699.** 36°00′ N, 18°58′ E. 7-2-1913. 5^{00} am. 3 spec.: 1 ♂ 4 mm, 2 ♂ jun. 3 mm. — **St. 718.** 36°13′ N, 13°53′ E. 17-5-1913. 8^{15} pm. 4 spec.: 1 ♂ 4 mm, 2 ♂ jun. 3 mm, 1 ♀ 2 mm. — **St. 729.** 41°00′ N, 17°44′ E. 14-4-1913. 5 spec.: 1 ♂ 4 mm, 2 ♂ juv. 3.5 mm, 2 ♀ 3 mm.

Atlantic.

St. 232. 9-9-1910. Surf. (P. 100), 9^{00} pm., 10 min. 19 spec.: 5 ♂ 4 mm, 1 ♂ jun. 3 mm, 13 ♀ 2 mm. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 8^{15} am., 30 min. 125 spec.: 43 ♂ 4 mm, 10 ♂ jun. 2—3 mm, 72 ♀ 2—3 mm. — **St. 377.** 31°23′ N, 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 8^{05} pm., 30 min. 65 spec.: 19 ♂ 3—4 mm, 10 ♂ jun. 3 mm, 36 ♀ 3 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. 32 spec.: 7 ♂ 3 mm, 6 ♂ juv. 3 mm, 19 ♀ 2—3 mm (1 with ova). — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. Surf. (S. 200), 12^{40} am., 30 min. Abt. 600 spec.: ca. 400 ♂ 3—4 mm, ca. 200 ♀ 2—3 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 9^{35} pm., 30 min. 102 spec.: 43 ♂ 3—3.5 mm, 59 ♀ 3 mm.

It must be considered an absolute fact that *H. promontorii* is the male of this species. While ♀ is easily recognized, ♂ has been subjected to various interpretations. Stebbing (1888) had besides ♀ only young ♂ of *H. schizog.* Bovallius (Monograph) says that he (B.) has had a full-grown ♂, but this does not seem likely from his description of uropoda, and Chevreux (l. c. 1900, p. 140) doubts whether the Bovallius ♂ belongs to this species at all. The adult ♂ was first described by Chevreux l. c. 1892, and his description l. c. 1900 is in the main only a reprint of the description from 1892, but with a number of additional figures.

Vosseler (1901) is inclined to think, that Chevreux' male is that of *H. Fabrei*, noting, in the first place, the points of resemblance between the Chevreux figure and Bovallius' figure (1889) of *H. Fabrei* (though without demonstrating the chief difference *viz.* p. 1 and p. 5—p. 7), and further its striking frequency. It is this very frequency of occurrence which seems to be the best proof that Chevreux has referred ♂ to the right ♀: no other ♀ belonging to any species of *Hyperia* is represented in the "Thor" collections from the Mediterranean in numbers even approximating to those represented by *H. schizogeneios*; and no other ♂ is so numerous as the one which may be determined as belonging to the Chevreux species. Moreover, the males and females in question have exactly the same occurrence.

In some of the males 1.—2. mesosome segments are fused, and these specimens should thus be determined as *H. promontorii.* But since there is no real disagreement between Stebbing's description of *H. promontorii* ♂ and Chevreux' description of *H. schizogeneios* ♂, apart from the fact that 1.—2. mesosome segments are said to be fused in *H. promontorii*, but free or at any rate "bien nettement délimités" in *H. schizogeneios*, I consider it a foregone conclusion that *H. promontorii* is the male of *H. schizogeneios*, as the fusion or non-fusion of the mesosome segments is a circumstance which may vary at any rate to some extent. A point in favour of my supposition is the fact that the female of *H. promontorii* is not known: true, Bovallius (l. c. p. 218, Pl. 11 figs. 7, 9, 12, 13) gives a short description and a few figures of a specimen, which he designates ♀, but in any case his figs. (12—13) of uropoda are taken from a ♂. Against my supposition stands the fact that the distinct process which on *H. schizogeneios* is to be found on the underside of the cephalon also on ♂ (though smaller and not so pointed as on ♀), according to Bovallius is said not to be found in *H. promont.* ("the head . . . . has the underside evenly rounded"); but in consideration of several positive misstatements in the work of Bovallius, there is hardly any reason to pay much attention to his remarks on this head.

Bovallius states (1889, p. 214) that he has borrowed the material of *H. promont.* from the Copenhagen Zoological Museum (but not of *H. schizogeneios*); we have, however, no specimens determined as *H. promont.*, but only a ♂ (5 mm, from 20° N, 26° W), determined by Bovallius as "*Hyperia macropis*", and this specimen is certainly a male of *H. promont.*

Sometimes there is in ♂ only one spine on the front margin of metacarpus in p. 1—p. 2, sometimes one on the one and 2 on the other, but as a rule there are 2 on

each. The telson in ♂ is as a rule of the shape shown by CHEVREUX in ♂, or the form drawn by STEBBING in *H. promontorii*; BOVALLIUS' figure (Pl. 11 fig. 12) is hardly in accordance with the actual facts.

As to the confusion of the female with the closely related *H. hydrocephala* and *H. macrophthalma* see the latter (p. 92). In small or comparatively small ♀ 1.—4, or even 1.—5. mesosome segments are sometimes fused, but sometimes there is a deep groove between 2. and 3. segment.

As the male of *H. hydrocephala* is not known, it is perhaps possible that it resembles the male of *H. schizogeneios* so closely as to have been confused with the latter.

The colour is said to be brown with black eyes (CHEVREUX 1900).

The material contains in all 1559 specimens, *viz.* from the Mediterranean 673 (473 ♂, 168 ♀, 32 juv.) and from the Atlantic 886 specimens (500 ♂, 386 ♀) or in all 973 ♂, 554 ♀ and 32 juv.

A. Mediterranean.

The material contains 673 specimens distributed over 52 stations, 63 hauls, as shown in the table below:

	No. of stations	No. of hauls	No. of specimens
June 1910	8	10	72
July —	10	11	40
Aug. —	12	14	307
Sept. —	8	8	169
Febr. 1911	1	1	2
March —	3	8	19
Aug. —	3	4	11
Nov. —	1	1	8
Dec. —	1	1	21
Feb. 1913	3	3	15
April —	1	1	5
May —	1	1	4
Total...	52	63	673

but the "Thor" itself has only 38 stations, 43 hauls, 588 specimens. The species occurs most frequently in August—Sept., on an average 21—22 specimens per haul, Aug.—Sept. 1910; in June and July the figures are only 7.2 and 3.7 respectively. Of these 52 stations 41 are in the western basin, and only 11 in the eastern.

Depth of the sea and occurrence. The vertical distribution of the stations of the "Thor" itself is as shown in the table:

Depths in m	No. of stations ("Thor")
0—500	6
> 500—1000	7
> 1000—2000	9
> 2000—3000	14
> 3000	2
total...	38

From this it appears that >500—3000 m. is the most frequent depth of the sea; only exceptionally has the species been taken at depths beyond these limits.

As mentioned above, the "Thor" itself has taken the species at 38 stations in all; subtracting from this the six with a depth of 0—500 m, there remain 32 stations; of these 28 are in the western, 4 in the eastern basin. As there are 17 negative stations in the western and 13 in the eastern basin (surface, night, P. 100, > 500 m) the total number of stations will be 45 and 17 respectively.

Night hauls, > 500 m, P. 100, surf.

No. of positive stat.		Total no. of stations		Percent. of pos. stat.	
W. Basin	E. Basin	W. Basin	E. Basin	W. Basin	E. Basin
28	4	45	17	62.2 %	23.5 %

From this it appears that while there are 62.2 % positive hauls in the western basin we have only a little over $^1/_3$ of that number in the eastern basin. Moreover, the hauls yielded much larger results in the western than in the eastern basin. 37 hauls yielded 564 or on an average abt. 15 spec. per haul, against 5 hauls with 24 or an average of abt. 5 specimens pr. haul. (It must be noted that the hauls, as far as this species is concerned, were on an average, only of 10 minutes duration, whereas in the case of nearly all the other species they lasted 30 min.)

Special emphasis should be given to the fact that the "Thor" did not take it at all on the winter cruise, whereas it has been taken all the year round by the other ships.

As will be seen from the chart, the species is to be found nearly everywhere in the western basin, as long as the depth is great enough; that it was taken in the Strait of Messina (St. 280—283) at lower depths than elsewhere, is a feature which it shares with many other species. In the eastern basin, on the other hand, it occurs much more sparsely, and is not found in the Adriatic; it does not penetrate far into the Ægean Sea, nor has it been found inside the Dardanelles. Though it must thus be said to belong to the ordinary species, and at any rate is the most common *Hyperia* —species in the western

Mediterranean, it has formerly only been found at a few places: Chevreux mentions it (l. c. 1892) from Garoupe at Antibes (the Bay at Genoa) and from Algiers: 37°36′ N, 4°18′ E and 36°59′ N, 2°48′ E. Lo Bianco (1902 p. 446; 1904 [German edition] p. 42) mentions 4 spec. (3 ♀ ad., 1 ♂ ad.) from south and south-east of Capri + 2 ♂ of *H. promontorii* from south-west of Capri; April, depth about 1000 m. Vosseler mentions it in Lo Bianco 1903 (table p. 278): 46 specimens from 12 hauls (6. Feb.—10. May) of which 9 hauls are south and south-east of Capri, 1 haul between Capo Corso and Monaco and 2 hauls at Salina and Stromboli (Æolian Isles), depth 900 (600) m — 2600 m; further 2♂ adult of *H. promontorii* south of Capri. Also Costa mentions it from the region round Naples.

Vertical occurrence. All the specimens were taken during the night at the very surface, as a rule at most 15 m. w., only in a very few cases with 40—122 m. w. Further, the "Thor" has only taken the species with implement P. 100. That the species has not been taken at greater depths by the "Thor" may perhaps be due to the fact that this implement was only used at the very surface, and that the nets used with a greater length of wire (in particular Y 200) are too large in the mesh to allow of these little animals being caught.

Besides the "Thor" material the only other large collections of the species (*H. schiz.* + *H. prom.*) from the Mediterranean are the above-mentioned made by Lo Bianco and Vosseler. All these 17 hauls have been made between 6. Feb. and 10. May and during the day (7.30 am.—5.00 p.m). In most of the hauls, the length of wire is 900—2000 m; 1 haul, however, has only 250 m. w., 2 hauls have 500 m. w., but on the other hand 1 haul has 2500 m.w.; one haul was made with closing net 100—0 m.

Propagation &c. The collections from the Mediterranean have nearly three times as many males as females. The two sexes attain the same size, abt. 4 mm (some single ♂ 5 mm); ♂ ad. and ♀ with ova are as a rule at least 3 mm. Animals of 1.5 mm can hardly be determined as to sex. Small individuals (1.5 mm) have been taken June—Sept. and females with ova in June, August, Sept. and March.

B. Atlantic.

The species is represented by 886 specimens from 6 stations, of which the one lies in the Bay of Cadiz, the other 5 west or south-west of this bay. The species has never been taken so near Europe. The "Thor" herself has only taken it at one of the above-mentioned stations, (in the Bay of Cadiz); as the "Thor" otherwise has 6 negative stations from the Strait of Gibraltar to Lisbon and 3 negative stations in the Bay of Biscay it can thus be considered an established fact that the species is not to be found at all off the coasts of Europe north of about 37° N. The depth of the sea is > 2600—> 4500 m or

Chart 13. *Hyperia schizogeneios.* ● potitive stations (st. 376—77 and 398—400 lie outside the chart to the S.W.). + negative stations (night, > 500 m, P. 100, 0—25 m. w.)

in other words greater than in the Mediterranean, but otherwise, the species seems to live under the same conditions in the two seas.

Distribution.

1. Mediterranean: see above.

2. Atlantic. Chevreux (l. c. 1892 and 1900) gives 281 specimens in all from 21 stations (138 ♂, 143 ♀) from the area west of the Azores 37°40′ N—42°50½′ N, 22°12′ W—45°25′ W, and also from Tenerifa, Sahara (18°51′ N, 0°19′ W) and 47°42¾′ N, 19°30¼′ W, which is the northernmost of all known occurrences. With the exception of an isolated find, all of his specimens are taken at the surface, during the night, i. e. just as with the material from the "Thor". Vosseler (1901) gives 13 ♀ of *H. schizog.* and 16 ♂ of *H. promont.* from 22 hauls in all, *viz.* the Azores 37.7° N, 25.2° W and 39.1° N, 23.5° W. N. Equatorial Current 2 st.: 24.6° N, 31° W, and 20.4° N, 37.8° W, 0—200 m. Florida Current 37.9° N, 59.1° W, surf. Sargasso Sea 35° N, 62.1° W, 0—400 m

Guinea Current 9.4° N, 41.9′ W, and 7.9′ N, 21.4′ W, 0—200 m. S. Equatorial Current 14 st.: 1.7° N, 17.3′ W to 6.8° S, 14.2° W; besides 2.4° S, 36.4° W and 1.5° S, 39.2° W; 0—200 or 0—400 m. — Bovallius mentions *H. schizogeneios* from Martinique and Caribbean Sea, and *H. promontorii* from 32°—45° S, 4°—20° E. — Stebbing ("Challenger") mentions *H. schizog.* from St. Vincent, Cape Verde Islands 16°49′ N, 25°14′ W, and *H. promont.* from 34°41′ S, 18°36′ E, surf. (off Cape of Good Hope), and the specimen in our Zool. Museum, mentioned above and seen by Bovallius, is from 20° N, 26° W. — Miss Stewart (1913) mentions *H. schizog.* from Bahia, 13°59′ S, 34°35′ W.

Taking all these data together, it appears that about 325 specimens are known from the Atlantic, almost exclusively from about 7°S—40° N but otherwise fairly evenly distributed over the whole of this area; from more southerly localities it is hardly known except from South-west Africa.

3. Pacific. ?Zebu Harbour, Philippines (Stebbing, 1888). In the Copenhagen Zoological Museum there is one (but lately determined) typical female labelled "Yeddo Bay, 19-8-1846, "Galatea", Reinhardt".

6. HYPERIA CRUCIPES Bovall.

Hyperia crucipes Bovallius, 1889, p. 225, Pl. 11 fig. 14—25.

Atlantic.

St. 265. 39°22′ N, 22°49′ W. 20-3-1911. 47 m.w. (S. 100), 7^{00} pm., 30 min. 1 ♀ 2.5 mm. — **St. 266.** 40°47′ N, 21°10′ W. 21-3-1911. 47 m.w. (S. 100). 7^{00} pm., 30 min. 1 ♀ 2.5 mm. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. (S. 200). 15 m.w., 8^{15} pm., 30 min. 1 spec. (♀?) 2.5 mm. — **St. 376.** ibid. 30 m.w. (S. 100), 8^{10} pm., 30 min. 2 ♀ (1 with ova) 2.5 mm. — **St. 377.** 31°23′ N, 18°08′ W. 23-7-1911. (S. 200). 15 m.w 8^{05} pm., 30 min. 6 ♀ 2.5—3.5 mm; 3 with ova or embryos. — **St. 383.** 37°16′ N, 14°9′ W. 23-10-1911. 30 m.w. (S. 100), 6^{05} pm., 30 min. 1 ♀ with ova 3 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200). 9^{10} pm., 30 min. 3 ♀ 2.5—3.5 mm.

There are in all 15 ♀ (no ♂) from the area north and north-east of the Azores, about $31^1/_2°$—$40^3/_4°$ N, 14°—$22^3/_4°$ W. The depth of the sea is very great, > 2600—> 5400 m, and all specimens were taken during the evening, either at or very near the surface.

Distribution. Off Barbadoes (Bovallius), Gulf of Manaar, Ceylon (Walker 1904, p. 236).

7. HYPERIA MACRODACTYLA n. sp. (Fig. 35).

Mediterranean.

St. 113. 28-6-1910. Surf. (P. 100), 3^{30} am., 10 min. 2 ♂ 2.5 mm. — **St. 145.** 25-7-1910. Surf. (P. 100), 3^{40} am., 10 min. 4 ♂ 2.5 mm. — **St. 176.** 12-8-1910. Surf. (P. 100), 4^{10} am., 10 min., 27 ♂ 2.5—3 mm. — **St. 217.** 1-9-1910. Surf. (P. 100), 1^{45} pm., 10 min. 1 ♀ 2 mm.

Of this species, which is new to science, the "Thor" has taken 34 specimens, *viz.* 33 males and only 1 female. The species is extremely characteristic, being distinguishable at first sight by its long and crooked dactyli in p. 3—p. 7, in conjunction with the fact that p. 5 is considerably shorter than p. 6—p. 7, whereas p. 3—p. 7 otherwise as a rule are of the same length.

♂ (fig. 35). Length 2.5—3 mm. Cephalon very large, nearly twice as deep as and a little longer than the three first mesosome segments together. On the underside there are, as in so many other species, a couple of quite small pointed processes. All mesosome segments are

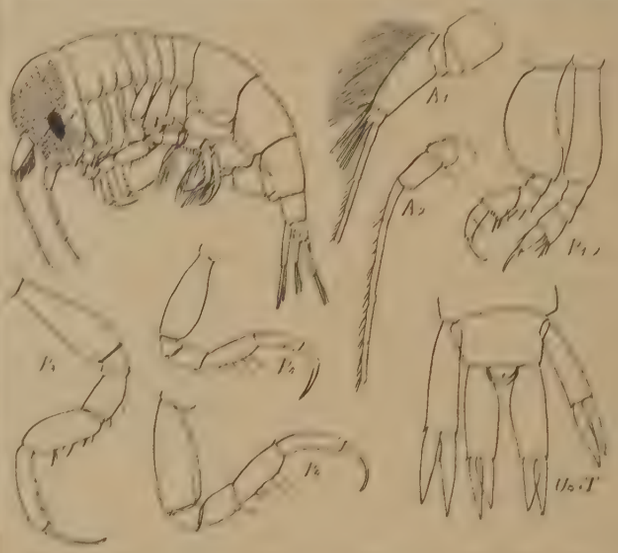

Fig. 35. *Hyperia macrodactyla* ♂, 3 mm, st. 176, 1910, surf.

somewhat of the same length, with the exception of no. 7, which is a little longer; the first 3 are fused and only half as deep as the cephalon. The mesosome a little longer than the 2, but shorter than the 3 metasome segments, each of which is nearly 3 times the length of each mesosome segment. The telson is broader than it is long, and only $^1/_4$ the length of the peduncle in up. 3; rounded triangular.

Ant. 1 at most as long as the pereion, ant. 2 a little longer, at times nearly as long as the whole animal. In p. 1—p. 2 2. joint is nearly the same length as the following joints together. In p. 1 2. joint is of a characteristically broad and curved form; the carpus is abruptly cut off with a process on the under margin, but not lengthened; the metacarpus is the length of the curved dactylus, with one bristle on the upper (front) margin. In p. 2 2. joint is a little broader at the distal than at the proximal end; the carpus has a small process, but there is no actual chela; the metacarpus and the dactylus nearly

as in p. 1. P. 3—p. 4 of the same length as p. 6—p. 7 and of nearly the same shape; 2. joint, however, is somewhat heavier in p. 6—p. 7 than in p. 3—p. 4. In p. 3—p. 7 the long curved dactylus is nearly as long as the metacarpus, in p. 7 even fully as long; the under margin of the carpus has 4—6 long setæ and a few smaller ones. Curiously enough, p. 5 is considerably shorter than p. 6—p. 7, in a few cases even only $^2/_3$ as long. Of the uropoda, up. 1 extends as far posteriorly as up. 3. In up. 1, the peduncle is slightly longer than the rami; the inner ramus is longer than the outer ramus and, like several other species, with a small excavation at the proximal end of the outer margin. Up. 2 resembles up. 1, but is shorter, and there is no excavation in the inner ramus. In up. 3 the peduncle is between $1^1/_2$ and 2 times as long as the outer ramus, and rather broad; the outer ramus is longer than the inner ramus; there is no excavation.

♀. The only ♀ is only 2 mm; it resembles ♂, but is a little heavier, and the inner ramus in up. 3 is a trifle longer than the outer ramus.

Distribution &c. All the specimens were taken in the Mediterranean, from south of the Balearic Islands to the Sea of Marmora (St. 176), and it is a strange fact, that 27 specimens were caught in the last mentioned locality. All specimens were taken at the surface during the night, the single ♀ during the day. The depth of the sea varies from > 500—3340 m.

8. HYPERIA THORACICA Bovall.

Hyperia thoracica Bovallius 1889, p. 233, Pl. 11 figs. 37—41. — *H. t.* Vosseler 1901, p. 73, Pl. 6 figs. 1—4.

Atlantic.

St. 400. 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 9^{35} pm., 30 min. 1 ♂ 3 mm.

In regard to the dorsal line and the size of the telson, the specimen entirely coincides with Vosseler's correction to Bovallius's description.

Bovallius states that he has borrowed specimens from the Copenhagen Museum, among others. There is, however, no specimen under this name, but one which Bovallius calls *H. Reinhardi*, though it is in reality *H. thoracica*. It was taken by Reinhardt 7°37′ N, 22°26′ W. and agrees entirely with the above-mentioned specimen from the "Thor"; but is 4 mm long (♂).

Distribution. 1. Atlantic. Vosseler mentions in the Plankton-Exped. 23 spec. (12 stations) from the Atlantic (+ 7 spec. from the China Sea). The localities were as follows: Florida Current 37.9° N, 59.1° W, surf.; Sargasso Sea 2 hauls 37.1° N, 59.9° W and 34.7° N, 62.4° W, 0—300 m and surf. N. Equatorial Current 28.9° N, 35° W, 5670 m, and 13.3° N, 22.7° W, 0—200 m. S. Equatorial Current 7 st.: 2.6° S, 14.6° W, surf.; 5.1° S, 14.1° W, 0—400 m; 6.9° S, 23.4° W to 0.3° S, 47.4° W, 0 or 0—400 m; 5.6° N, 44° W, surf. Mouth of Rio Tocantin (S. America) 0.2° S, 47° W, 0—35 m. — Bovallius' specimens were from 13°—20° N, 43°—50° W. — Thus the species is distributed in the warm Atlantic 7° S—38° N.

2. Pacific. China Sea, without special locality (Vosseler, l. c.).

9 a. HYPERIA HYDROCEPHALA Voss.

(Chart 14 partim).

Hyperia hydrocephala Vosseler 1901, p. 74, Pl. 6 figs. 26—28, Pl. 7 figs. 1—5. — *H. h.* Steuer 1911, p. 677, Pl. 2. — ?*H. macrocephala* Vosseler (see below). — ?*H.* sp. ?*hydroceph.* Vosseler, Pesta 1920 p. 30—31, figs.

Mediterranean.

St. 115. 28-6-1910. Surf. (P. 100), 11^{30} pm., 10 min. 1 ♀ 2.5 mm. — **St. 116.** 30-6-1910. Surf. (P. 100), 1^{50} am., 10 min. 6 spec.: 1 ♂ jun. 2 mm, 5 ♀ 2 mm. — **St. 118.** 30-6-1910. Surf. (P. 100), 11^{05} pm., 10 min. 5 spec.: 1 ♂ jun. 2 mm, 4 ♀ 2—3 mm. — **St. 129.** 12-7-1910. Surf. (P. 100), 3^{10} am., 10 min. 3 spec.: 2 ♂ jun. 2 mm, 1 ♀ 2 mm. — **St. 133.** 14-7-1910. Surf. (P. 100), 9^{30} pm., 10 min. 1 ♀ 2.5 mm. — **St. 163.** 5-8-1910. Surf. (P. 100), 0^{15} am., 10 min. 8 ♀ 1—3 mm. — **St. 142.** 22-7-1910. Surf. (P. 100), 3^{00} am., 10 min. 1 jun. 2 mm. — **St. 197.** 24-8-1910. Surf. (P. 100), 7^{10} pm., 10 min. 1 jun. 1.5 mm. — **St. 205.** 28-8-1910. Surf. (P. 100), 7^{40} pm., 10 min. (10×) 9 spec.: 3 ♂ jun. 2—2.5 mm, 6 ♀ 1—2.5 mm. — **St. 206.** 28-8-1910. 1^{10} am. Surf. (P. 100). 10 min. 50 spec.: 5 (♂ jun.?) 2 mm, 45 ♀ 1—3 mm. — **St. 223.** 5-9-1910. 4^{40} am. Surf. (P. 100), 10 min. 1 (♂ jun.?) 2 mm, 11 ♀ 1—3 mm. — **St. 224.** 5-9-1910. 7^{25} pm. Surf. (P. 100), 10 min. 46 ♀ 1—3 mm. — **St. 279.** 23-2-1911. 7^{00} pm., 30 m.w. (S. 100), 120 min. 2 ♀ 3 mm. — **St. 282.** 8-3-1911. 10^{45} pm., 40 m.w. (S. 100), 120 min. 1 ♀ 3 mm. — **St. 282.** ibid. 9^{00} pm., 40 m.w. (S. 100), 90 min. 1 ♀ 3 mm. — **St. 282.** ibid. 2^{00} am., 40 m.w. (S. 100), 60 min. 1 ♀ 2 mm. — **St. 698.** 37°20′ N, 9°25′ E. 25-2-1913. 5^{00} am. 2 ♀ 3 mm. — **St. 718.** 36°13′ N, 13°53′ E. 17-5-1913. 8^{15} pm. 15 ♀ 2—3 mm. — **St. 729.** 41°00′ N, 17°44′ E. 14-4-1913. 11^{30} (pm.?). 1 ♀ with ova 3.5 mm.

As shown by the above, the collections of the "Thor" comprise a fairly large material of this species (247 spec.), but only from the Mediterranean.

On the whole, the specimens agree very well with the descriptions and figures of Vosseler and Steuer. In several of the specimens, which, by the way, are typical. 5. mesosome segment is free, not coalesced with 1.—4. segments, which are fused, and a few of the specimens have only 1 seta (not 2) on the metacarpus of p. 1—p. 2.

With its thick head and inflated pereion, the female of this species reminds one very much of the female of *H. schizogeneios*, and confusion is all the more possible, as the two species often appear in the same haul; it will quickly be identified, however, by the processes on the under side of the head, which are rounded and curved forward, not pointed, and the large wing on the front margin of 2. joint in p. 1.

For its relation to *H. macrophthalma*, which is undoubtedly synonymous with it, see below.

Material. The "Thor" has taken in all 247 spec. (37 ♂, 205 ♀, 8 juv.) which is remarkable, as only 4 spec. (♀) are otherwise recorded in extant literature; males are evidently much rarer than females.

Chart 14. *Hyperia hydrocephala* and *H. macrophthalma*.

Occurrence. Nearly all the specimens are from the western basin, but a few were found right up in the Ægean Sea (St. 163). The only specimen previously found in the Mediterranean is a female juv. from the Bay of Trieste (Steuer l. c.[1]). The depth of the sea is on an average very great, 1000—3400 m though a few individuals were taken at smaller depths, 98—600 m.

Vertical occurrence. All specimens were taken at the surface, during the night.

Propagation. The only female with ova was taken in April.

Distribution. 1. Mediterranean (see above).

2. Atlantic. In Plankton-Exp. Vosseler mentions in all 3 ♀ from the North Equatorial Current 26.3° N, 32.5° W, 0—400 m, and 12° N, 40.3° W, 0—200 m, and from the South Equatorial Current 0.1° N, 15.2° W, 0—200 m. Other occurrences not mentioned in extent literature.

[1] Pesta (1920, p. 30) mentions 3 ♀ as *Hyperia* sp.? *hydrocephala* Vosseler from the Adriatic (42°11.3′ N, 17°47′ E, surf., and 43°5.6′ N, 15°18′ E, 120 m. w.).

9 b. HYPERIA MACROPHTHALMA Voss.
(Chart 14, partim).

Hyperia macrophthalma Vosseler, 1901, p. 70, 75; Pl. 6 fig. 16—25.

Mediterranean.

St. 163. 3-8-1910. Surf. (P. 100), 0^{15} am., 10 min. 1 ♀ 2 mm. — **St. 163.** ibid. 25 m.w., 1^{35} am. 2 ♀, 3.5 mm and 2.5 mm. — **St. 205.** 28-8-1910. Surf. (P. 100). 7^{40} pm., 10 min. 70 ♀ 2 mm. — **St. 281.** 1-3-1911. 40 m.w. (S. 100), 7^{50} pm. 60 min. 1 ♀ 3 mm.

Atlantic.

St. 386. 36°30′ N, 7°30′ W. 15-11-1911. 122 m.w. (S. 150), 5^{00} am., 30 min. 1 ♀ 3 mm.

H. macrophthalma can undoubtedly not be maintained as a species, but is synonymous with *H. hydrocephala*. As regards the chief points of difference between the two "species" see Vosseler 1901, p. 75—76. In the following I propose to give a survey of the deviations between Vosseler's description and figures and my own material. Vosseler had only 8 specimens.

My determination of the species as *H. macrophthalma* is based on the fact that the first segment of the urosome is hardly shorter than the last segment of the metasome. It is not necessary to pay special attention to the proportion between length and breadth of the carpus in p. 1—p. 2, as this seems to vary according to age. Most of the specimens have 2 setæ (not 1) on the front margin of the metacarpus in p. 1—p. 2, which should be a character of *H. hydroceph.* In p. 3—p. 4 the dactylus is at most half as long as the metacarpus; according to Vosseler's text it should be shorter, which agrees well with his figure (Pl. 6 fig. 23) of p. 3, whereas his figure (fig. 24) of p. 4 represents the dactylus as far too short. In my spec. the proportions in up. 1 resemble *H. hydroceph.*, not *H. macrophth.* whereas up. 3 agrees with Vosseler's description.

Material. Of this form, of which only 8 spec. (all ♀) were previously known, the "Thor" has taken 74 spec. in the Mediterranean, 1 in the Atlantic.

all ♀; it is new to the Mediterranean (see chart 14 p. 92).

All that was said above of *H. hydrocephala* as to distribution &c. holds good of this species as well; only the specimen from the Atlantic was taken at somewhat lower depth *viz.*, with 122 m. w.

Distribution. 1. Mediterranean. New to this sea.

2. Atlantic. The material collected by the "Thor" advances the northern limit of the species as far as the Bay of Cadiz. Previously, it was (Vosseler l. c.) only known from 6 hauls 16.1° N—5.3° N, 21.4° W—35.2° W, 0 or 0—200 m *viz.*, North Equatorial Current 16.1° N, 23.1° W; Guinea Current 7.9° N, 21.4°. W, and 4 hauls in the South Equatorial Current 0.1° N, 15.2° W to 5.3° S, 27.6° W and 2.8° S, 35.2° W, 0—200 m or surface.

As will be seen, the geographical distribution coinsides with what is known of *H. hydrocephala.*

4. Genus Hyperioides Chevreux.

**Hyperioides* Chevreux 1900, p. 143. — *Parahyperia* Vosseler 1901, p. 56. — *Hyperioides* Stebbing 1904, p. 34.

1. HYPERIOIDES LONGIPES Chevreux.

**Hyperioides longipes* Chevreux 1900, p. 143, Pl. 17 fig. 2. — *H. l.* Lo Bianco 1902, p. 422, 427. — *H. l.* Walker 1903, p. 229, Pl. 19 figs. 7—13. — *H. l.* Stebbing 1904, p. 34, 35, and 49, 53 (Fowler). — *H. l.* Chevreux 1913, p. 6. — *H. l.* Vosseler, in Lo Bianco 1903—04, p. 278. — *Hyperia sibaginis* Vosseler (non Stebbing) 1901, p. 60, Pl. 7 figs. 6—20 (*Parahyperia* p. 56, *Hyperia sibaginis* var. *longipes*, *Hyperia longipes* p. 63).

Mediterranean.

St. 10. 15-12-1908. 600 m.w. 3^{45} pm. 60 min., 1 ♂ 5 mm. — **St. 115.** 29-6-1910. 65 m.w., 1^{20} am., 15 min. 1 ♀ 4 mm. — **St. 118.** 30-6-1910. Surface (P. 100), 11^{05} pm., 10 min. 1 ♂ 4 mm. — **St. 120.** 1-7-1910. 300 m.w., 8^{50} pm., 30 min. 1 ♀ 5 mm. — **St. 122.** 2-7-1910. 600 m.w., 10^{00} am., 60 min. 2 ♀ with ova 4—5.5 mm. — **St. 122.** ibid. 1200 m.w., 5^{30} pm., 60 min. 3 ♀ 6, 5, 5 mm. — **St. 129.** 12-7-1910. 600 m.w., 8^{00} pm., 30 min. 1 ♀ 4 mm. — **St. 133.** 14-7-1910. 600 m.w., 9^{20} pm., 30 min. 1 ♀ 4 mm. — **St. 202.** 26-8-1910. 300 m.w. 5^{05} pm., 15 min. 1 ♀ 4 mm. — **St. 209.** 29-8-1910. 1000 m.w., 6^{00} am., 45 min. 1 ♀ with embryos 5 mm. — **St. 209.** ibid. 2000 m.w., 7^{25} am., 45 min. 1 ♀ with ova 5 mm. — **St. 210.** 30-8-1910. 600 m.w., 3^{35} am, 30 min. 1 ♀ with ova 5 mm. — **St. 279.** 23-2-1911. 30 m.w. (S. 100), 7^{00} pm., 120 min. 2 ♂ (1 jun., 1 adult) 3.5 mm, 2 ♀ 3 mm. — **St. 280.** 25-2-1911. 15 m.w. (S. 100). 5^{20} pm., 120 min. 1 ♂ 4 mm, 1 ♂ jun. 4 mm. — **St. 281.** 1-3-1911. 30 m.w. (S. 100), 3^{44} pm., 120 min. 4 ♂ 4 mm, 8 ♀ (1 with ova) 4 mm. — **St. 281.** 1-3-1911. 10 m.w. (S. 100). 4^{55} pm., 120 min. 2 ♂ 4 mm, 1 ♀ with ova 2 mm. — **St. 281.** ibid. 40 m.w. (S. 100). 6^{10} pm., 120 min. 5 ♂ adult 3.5 mm, 3 ♂ jun. 3.5 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 7^{50} pm., 120 min. 3 ♂ (1 jun.) 3 mm, 2 ♀ (1 with ova) 3.5 mm. — **St. 282.** 8-3-1911. 40 m.w. (S. 100), 7^{15} pm., 90 min. 1 ♀ 3 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 9^{00} pm., 90 min. 1 ♂ 4 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 10^{45} pm., 180 min. 3 ♀ (2 with embryos) 3 mm, 1 ♂ jun. 3 mm. — **St. 282.** ibid. 9-3-1911. 40 m.w. (S. 100). 2^{00} am., 90 min. 1 ♂ jun. 3 mm, 11 ♀ (3 with ova) 3 mm. — **St. 283.** 12-3-1911. 40 m.w. (S. 100), 6^{30} pm., 180 min. 1 ♂ 4 mm, 3 ♀ (1 with embryos) 3.5 mm, 1 ♀ 3 mm. — **St. 283.** 13-3-1911. 40 m.w. (S. 100). 9^{45} pm., 180 min. 3 ♂ (1 jun.) 3.5 mm, 2 ♀ 3.5 mm.

Atlantic.

St. 82. 51°00′ N, 11°43′ W. 14-6-1905. 300 & 600 m.w. (Y. 330), hour?, min.? 3 ♂ adult 6 mm, 4 ♂ jun. 4—4.5 mm, 52 ♀ 4—5 mm. — **St. 82.** ibid. 15-6-1905. 800 m.w. (Y. 330), 120 min. 3^{45} pm. 1 ♂ juv. 4 mm, 2 ♀ 4 mm. — **St. 82.** ibid. 800 & 1200 m.w. (Y. 330), hour?, min.?, 1 ♂ 5 mm. — **St. 82.** ibid. 1200 m.w. (Y. 330). 0^{45} pm., 120 min. 13 ♂ adult 5—6 mm, 8 ♂ jun. 4—5 mm, 1 ♂ jun. 3 mm, 15 ♀ 3—5 mm. — **St. 179.** 47°20′ N, 12°23′ W. 3-9-1906. 300 m.w. (Y. 330). 9^{30} pm. 120 min. 1 ♀ 5 mm. — **St. 180.** 48°19′ N, 13°53′ W. 3-9-1906. 1800 m.w. (Y. 330), 5^{05} pm., 60 min. 2 ♂ 4—5 mm. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 30 min., 8^{15} pm. 2 ♂ adult 3 mm. — **St. 377.** 31°23′ N, 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 8^{05} pm., 30 min. 1 ♂ 3 mm.

A. Mediterranean.

Material and occurrence. There are 78 spec. (31 ♂, 47 ♀) from 16 stations, 23 hauls. The species was taken almost exclusively in the western basin. On the border of the eastern basin it was taken at 5 stations (St. 279—83) in the Strait of Messina, and within the eastern basin only (St. 10) close to the south-east of the Strait of Messina.

The depth of the sea must no doubt be put at 500 m—> 3000 m; true, in the Strait of Messina the species was taken several times at 200 m, indeed, once even at 5—8 m.

Depth of the stations	No. of stations
0— 200 m	1
> 200— 500 -	5
> 500—1000 -	3
> 1000—2000 -	1
> 2000—3000 -	5
> 3000 -	1
Total...	16

Vertical occurrence.

m. w.	No. of night hauls	No of spec.
10—40.....	10	47
50—100.....	1	1
135—250.....	—	—
300.....	1	1
> 300	4	4

There does not seem to be any doubt that the species, during the night, chiefly keeps quite close to the surface.

During the day it stays deeper down (300—2000 m.w.), there are, however, 3 day hauls (St. 280—81) with only 10, 15 and 30 m. w. For data from extant literature see under Distribution.

Propagation. Females with ova or embryos were found in July and August, but particularly in March. Males and females seem to attain the same size, about 5 mm.

B. Atlantic.

From the Atlantic there are 106 spec. (36 ♂, 70 ♀); as in the case of the material from the Mediterranean, there are thus more females than males. It was taken at 5 stations, 8 hauls. It seems to follow the same laws as in the Mediterranean; north of 40° N, however, it is only found considerably deeper down than in more southerly regions (see under Distribution), and nothing can be said as to the propagation.

Distribution.

1. Mediterranean. Vosseler (1901) records 4 spec. from Naples, and Lo Bianco mentions it (1903, p. 235) as having been found at Capri and belonging to the Panteplankton. Chevreux mentions it (l. c. 1913) as common at Monaco, taken with 0—800 m. w. and from 9 stations in the western Mediterranean, without further data. Lo Bianco (l. c. 1901, and German edition 1904 p. 43) mentions in all 8 spec. from 2 day hauls at Capri; 500 and 1500 m. w.

The best biological data of the species in the Mediterranean, to be found in extant literature, are those which can be derived from the table of Vosseler (Lo Bianco l. c. 1903). Here mention is made of 116 spec. from 24 hauls, 5. Feb.—8. April, all day-hauls. All of them lie round Capri except 3 between Capo Corso and Monaco, and 1 at Salina (Æolian Isles). The depth is 600—2600 m (with the exception of 1 station at 100 m). The length of line is as a rule very great, 900—2000 (2500) m; there are, however, the following exceptions: 1 haul has only 50 m. w. (9.20—9.50 am.), 3 hauls with a closing net, 100, 300 and 400 m. w. respectively, and 1 haul 500 m. w.; but it has also been taken with closing net with 1100 and 2000 m. w. From this it appears that during the day the species as a rule lives very deep down.

2. Atlantic. On the West of Ireland it seems to be quite common, which — apart from the "Thor" investigations — appears from the work of Tattersall (1906, p. 23). The species seems to have its northern limit here, but as a rule, it has been found at lower levels than further south and west: Tattersall (l. c.) mentions having taken it in 30 hauls, 200—1500 fms. down, and Walker (l. c.) records it from 2 hauls, also from West Ireland, 150—510 fms. down; neither of these authors, however, states whether they are night or day hauls. Stebbing (l. c.) mentions 32 hauls from the Bay of Biscay, most of them 100 fath. below the surface; it is thus already found nearer the surface here than further north, but lives at much lower levels than further south. The great depths towards the north are perhaps due to the fact that the hauls are day hauls.

The species seems to be one of the most widely distributed Hyperiidea in the northern Atlantic. When data are given in extant works as to the number of specimens, the numbers are always rather small as far as the individual hauls are concerned, but it is very widely distributed. The "Princesse-Alice" and "Hirondelle II" have taken it at 43 stations, localities not stated. Chevreux l. c. 1913, and the "Hirondelle" has taken it at 4 stations from the Bay of Biscay to the Azores, or within the area investigated by the "Thor".

The German Plankton-Exp. (Vosseler 1901) has taken it at 40 stations in the northern Atlantic (68 spec.: 28 ♀ 40 ♂) distributed in the following manner: Gulf Stream 2 st. 41.1° N, 21.1° W, to 43.6° N, 17.9° W, 0—350 (400) m. Florida Current 5 st. 40.4° N, 57° W to 37.1° N, 59.9° W, 0 or 0—200 (400) m. Sargasso Sea 15 st.: 33.2° N, 63.8° W to 31.5° N, 59° W; 30.8° N, 51.1° W; 31.2° N, 48.5° W, to 25.6° N, 34.9° W; 27.8° N, 33° W, 0—400 (200) m. N. Equatorial Current 6 st. 28.9° N, 35° W to 16.1° N, 23.1° W, 0—400 (500) m. Guinea Current 2 st. 9.4° N, 41.9° W and 7.9° N, 21.4° W, 0—400 m. S. Equatorial Current 9 st.: 1.7° N, 17.3° W, to 0.3° S, 15° W, 0—200 (500) m; 7.8° S, 17.3° W, to 1.5° S, 39.2° W, 0—400 (200) m; 0.4° N, 46.6° W, and 5.6° N, 44° W, 0—200 or 0—400 (500) m. Mouth of Rio Tocantin 0.7° N, 48.2° W, 0—12 m. The temp. at the surface was 24.2° (23.4°) to 27.5° (28°) C, but in the Gulf-Stream 16.2° and 17.6°; the salinity (surface) 34.8 ‰—37.3 ‰ (in Rio Tocantin 11.4 ‰).

5. Genus Themisto Guérin.

(= *Parathemisto Boeck* + *Euthemisto Bovall.*).

Themisto Guérin, Uroptère; Encyclopédie Méthodique, Hist. Nat., vol. 10, 1825, p. 772. — *Parathemisto* Boeck 1870, p. 87 (7). — *P.* Bovallius 1889, p. 248. — **P.* G. O. Sars 1895, p. 10. — *P.* Vosseler 1901, p. 80. — *Euthemisto* Bovallius, Syst. list 1887, p. 21. — *E.* Bovallius 1889, p. 275 (lit.). — *E.* Stebbing 1888, p. 1407

(lit. and syn.). — **E. G. O. Sars 1895, p. 11. — *Themisto* K. Stephensen 1923, p. 19.

On the European species.

In 1870 (1871) Boeck established the genus *Parathemisto*, which was to be distinguished from genus *Themisto* Guérin (altered by Bovallius in 1887 to *Euthemisto*) by p. 5 not being (essentially) longer than p. 6—p. 7. Various authors, however, have clearly seen that the two genera are very nearly related; Norman & Scott say (Crust. of Devon and Cornwall 1906 p. 55) that "*Euth. compressa* is a connecting link." The confusion caused by the name of "*Euthemisto gracilipes*" (by other authors it has evidently been determined sometimes as *E. compressa*, sometimes as *P. oblivia* [Tesch 1911, p. 184—85] which latter again has been considered synonymous with *P. abyssorum*) clearly points in the same direction.

After carefully examining the material of the "Thor", I think I may say with certainty that the three genera ought to be combined. The name should then be *Themisto* after the first established genus, it having been proved that on the male, which must be referred to *T. gracilipes* Norm., p. 5 is considerably longer than p. 6, whereas these two pairs of legs are of the same length in the female, so that the latter should be referred to gen. *Parathemisto*, whereas ♂ is to be referred to genus *Euthemisto* (see further under the species in question).

A key to the European species is given in my paper 1923, p. 19; all these species were taken by the "Thor", except *T. libellula* (which is arctic).

The summary below gives an idea of the affinities of the species:

T. abyssorum — *T. gracilipes* — *T. compressa* f. *compressa*.
| /
T. compressa f. *bispinosa* — *T. libellula*.

From this it appears that both *T. compressa* (incl. the two forms) and *T. abyssorum*, though sharply distinguished one from the other, can nevertheless both be confused with *T. gracilipes*.

In young individuals of *T. compressa* (and *T. bispinosa*) the carpal process in p. 2 is often even as short as in the adult *T. gracilipes*. On the whole, it is difficult to determine young specimens, with the exception of *T. libellula* of which even quite small specimens (2—3 mm) always have the characteristic spines on the dactylus in p. 5 distinctly developed.

For further data see the individual species.

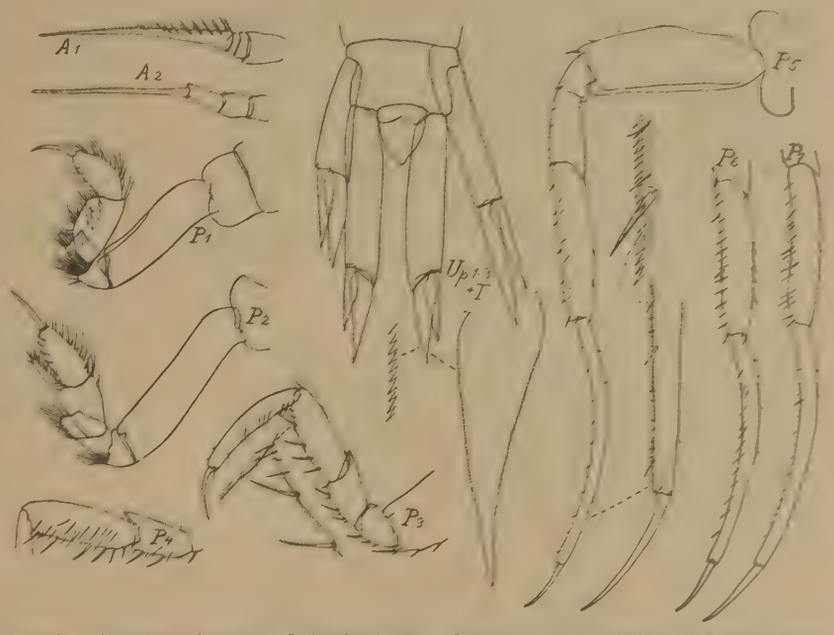

Fig. 36. *Themisto abyssorum* ♀ (without ova), 21 mm, st. 124, 1905. All figures drawn to the same scale except the detail figures of p. 3, p. 5 and up. 3.

1. THEMISTO ABYSSORUM Boeck (Figs. 36—38).

Parathemisto oblivia G. O. Sars 1895, p. 10, Pl. 5 fig. 1. — *Themisto abyssorum* K. Stephensen 1923, p. 20 (lit. and syn.).

Atlantic.

St. 124. 1075 m. 61°04′ N, 4°33′ W. 23-7-1905. 1000 m.w. 21 spec.: 19 ♀ 12—21 mm, 2 ♂ 7 mm.

Parathemisto abyssorum Boeck 1870, p. 7 (87) and *Hyperia oblivia* Krøyer 1838, p. 298 (70), Pl. 4 fig. 9 are considered synonyms by nearly all authors; but this is no doubt incorrect, and *H. oblivia* is probably identical with *Parathemisto gracilipes* Norman (p. 102).

Unfortunately, no comparison of the type-specimens could be made, as the only type of Krøyer is lost (see H. J. Hansen 1887, p. 57) which is all the more to be regretted, as Krøyer's text is incomplete and his figures too small, besides containing some mistakes (also the 9 specimens of "*Parathemisto abyssorum*" from

Greenland, found among the effects left by KRÖYER and mentioned by H. J. HANSEN 1887, p. 57, are lost).

Parathemisto abyssorum Boeck differs from *P. (Hyperia) oblivia* Kröyer in having the carpi of p. 3—p. 4 only slightly dilated, elongate ovate, — not broadly ovate; — while ant. 1 ♀ is straight and thin, not curved and heavy.

Of ant. 1 in *H. oblivia*, KRÖYER says that 4. joint (flagellum) is more than double the length of the three preceeding joints combined, strongly pointed and very curved. BOECK himself in respect of *P. abyssorum* only says of ant. 1 ♀, that it is abt. as long as the head is high (BOVALLIUS [1889, p. 251] has an excellent original figure [drawn by WESTERGREN] of BOECK's type; this figure is much better than that by BOECK himself). SARS, however, who (l. c. 1895) evidently only has described the species of Boeck, says that ant. 1 ♀ are "about as long as the cephalon and the first segment of the mesosome combined, flagellum only very slightly curved, about three times the length of the peduncle" (he says nothing of the thickness in proportion to ant. 2, but it appears from his fig. that the flagellum of ant. 2 in thickness agrees with the distal two thirds of ant. 1.)

Altogether, my specimens agree well with the descriptions and figures given by BOVALLIUS (1889) and SARS (1895); the specimens described by both of these authors undoubtedly belong to the species of BOECK, but BOVALLIUS' list of synonyms also comprises the species of KRÖYER.

For relation to the other species see genus *Themisto* (p. 95) and *T. gracilipes* Norman.

In the following, some additions are made to the descriptions of BOECK, BOVALLIUS and SARS quoted above.

♀ (figs. 36—37). (I have in particular examined one specimen of 21 mm from St. 124, 1905, and one specimen of 5.5 mm from St. 173, 1905 (Skagerrak), 300 m. w.). The first pair of antennæ are of the same length as, or a little longer than, the second one, reckoned from the basis of both; but this does not mean that the apices of the two pairs of antennæ in their natural position would lie side by side, the apex of the first pair never quite extends to the apex of the second. Ant. 1 is straight or very slightly curved (never the shape of a hook); for further particulars see above. In the large female (21 mm) ant. 1 is considerably slenderer than on the small one (5.5 mm).

On the metacarpus of the large specimen p. 1—p. 2 are much more setose than shown by the above-mentioned writers, which undoubtedly stands in relation to the sizes of the animals; as it will appear from my figures, the quantity of setæ increases very much with the size.

In p. 3 the metacarpus in the small spec. is twice as long as it is broad; in the large ones, the proportion is as 3:1; in p. 4, the corresponding proportion is 3:1 and 7:2; the length thus increases with age, in proportion to the breadth.

P. 5—p. 7 become slenderer, as the animal grows older, in particular 6. joint, which in p. 5 of the large specimen is about 19 times, in the small specimen only 14 times as long as it is broad. In the small specimen, the teeth on the front margin of 6. joint are finer, but

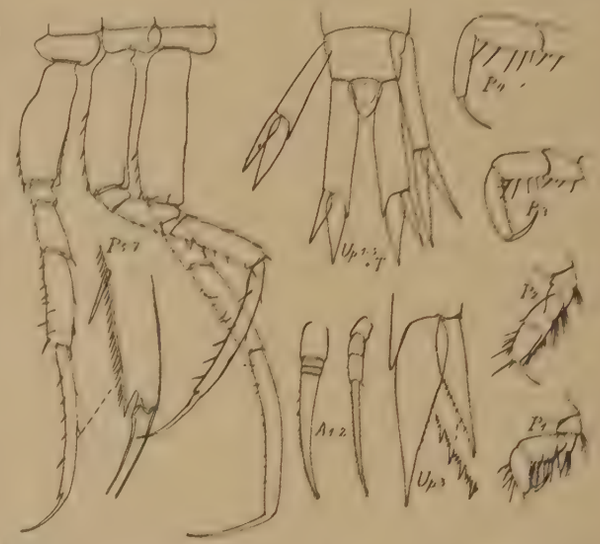

Fig. 37. *Themisto abyssorum*, ♀, 5.5 mm, st. 173, 1905, 300 m.w. All figures drawn to the same scale except the details of p. 5 and up. 3.

the spines are relatively bigger and fewer than in the large specimen. The dactylus is proportionally much longer in the small specimens, but in the small as well as in the large specimens the dactylus is considerably longer in p. 7 than in p. 5; in the small ones it is even half as long as the metacarpus.

The 3 pairs of uropoda are longer and slenderer in the large specimen than in the small one. The processes at the distal end of the inner margin of the peduncle in up. 2—3 become shorter, but much broader, as the individual grows older. In the large specimen, the inner ramus in up. 3 is serrate along both margins, in the young one only along the outer edge.

♂ (fig. 38). The figures and the remarks given below apply to one of the largest specimens in the "Thor" material, 8 mm, St. 173, 1905, 200 m. w.

As appears from the works both of SARS and BOVALLIUS, there is, apart from the antennæ, no great sexual difference in this species. Both of them, however, have overlooked the fact that the uropoda are somewhat heavier in ♂ than in ♀, and that in ♂ there is an excava-

tion in the inner and outer edge of the outer and inner rami of the up. 1. (Bovallius fig. 16 [Monograph] is

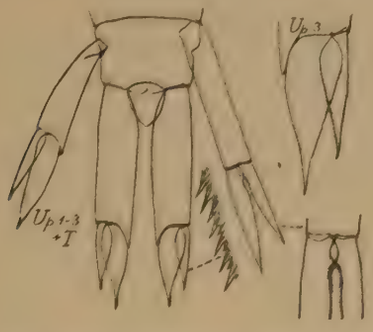

Fig. 38. Themisto abyssorum Boeck, ♂, 8 mm, st. 173, 1905, 200 m.w.

in reality of a female, not a male). Besides ♂ is a trifle slenderer than ♀.

Size. See my paper l. c. 1923, p. 24.

Distribution. An almost purely arctic, probably circumpolar species; for special localities see my paper l. c. 1923, p. 20 (with chart).

2. THEMISTO GRACILIPES Norman.

(*Themisto compressa* var. *gracilipes* Norman) (figs. 39-42).

Hyperia gracilipes + (?)*H. oblivia* Norman, Last Report Dredging Shetland; Brit. Assoc. Report for 1868 (1869), p. 287. — *Parathemisto gracilipes* Bovallius 1889, p. 268 (with reproduction of description and figures given by Bate & Westwood 1868). — *P. g.* Th. Scott, Fishery Board for Scotland, 10th Report, pt. 3, 1891 (1892), p. 265. — *P. g.* Norman 1900, p. 131. —*Euthemisto gracilipes* Norman & Scott, Crust. of Devon and Cornwall 1906, p. 54 (lit. and syn.). — *E. g.* Brady & Norman 1909, p. 301. — *E. compressa* var. *gracilipes* Norman, The Celtic Province, its extent and its marine fauna; Transact. Hertfordshire Nat. Hist. Soc., Hertford, vol. 14, pt. 1, 1909, p. 26 (note). — *E. g.* + *E. compressa* (partim) + *P. oblivia* (partim) Tesch 1911, p. 184, 183, 180, Pl. XXV. — *E. compressa* (young stage) Tattersall 1906, p. 24, 36 (partim). — *E. c.* Steuer 1911, p. 9. — *P. longipes* Bovallius, Syst. list 1887, p. 21 (teste Bovallius 1889). — *P. abyssorum* Fowler, Proc. Zool. Soc. London, 1898, pp. 583—85, § IV (not § I—III, being the true *P. abyss.* Boeck). — ?*Hyperia oblivia* Krøyer 1838, p. 298 (70), Pl. 4 fig. 19. — *H. o.* Sp. Bate 1862, p. 298, Pl. 49 fig. 5 (teste Norman 1906). — *H. o.* Sp. Bate & Westwood 1868, p. 16, textfig. (teste Norman 1906). — *H. o.* Edward, Journ. Proc. Linn. Soc., vol. 9, 1867, p. 143, 166 (teste Norman 1900). — ?*Parathemisto oblivia* Chevreux 1900, p. 145. — ?*P. o.* Walker 1903, p. 223, 230. — ?*P. o.* Stebbing 1904, p. 36 (partim). — ?*P. o.* Tattersall 1906, p. 5, 24. — ?*P. o.* Chevreux 1913, p. 6. — ?*P. o.* Stewart 1913, p. 257. — ?*P. o.* + *Euth. grac.* Tesch 1915, p. 321, 322, 351, 352. — ??*Euth. Gaudichaudii* Stebbing 1888, p. 1411, Pl. 173 (not Pl. 172).

Mediterranean.

St. 12. 19-12-1908. 65 m.w. 1^{00} pm., 30 min. 4 spec. 5.5 mm: 1 ♂ ad., 3 ♀ (1 with ova). — **St. 18.** 30-12-1908. 300 m.w., 9^{30} pm.(?), 60 min.(?). 1 ♂ jun. 7 mm. — **St. 106.** 25-6-1910. 1200 m.w., 0^{30} am., 60 min. 1 ♀ 6 mm. — **St. 107.** 25-6-1910. 65 m.w., 9^{50} am., 15 min. 1 ♀ jun. 4 mm. — **St. 123.** 3-7-1910. 65 m.w., 0^{05} am., 30 min. 2 spec.: 1 ♂ ad. 5 mm, 1 ♀ with ova 6 mm. — **St. 183.** 16-8-1910. 300 m.w., 4^{45} pm., 15 min. 20 spec.! 3 ♂ ad. 6 mm, 17 ♀ (4 with ova 5—7 mm) 4—7 mm. — **St. 729.** 41°00′ N, 17°49′ E. 14-4-1913. 30 spec.: 17 ♂ ad. 4—5 mm, 13 ♀ (4 with ova) 5—6 mm.

Atlantic.

St. 72. 57°52′ N, 9°53′ W. 8-6-1905. 1500 m.w. 3 spec.: 1 ♂ jun. 5 mm, 2 ♀ 4 mm. — ?**St. 88.** 48°09′ N, 8°30′ W. 20-6-1905. 300 m.w. 33 ♀ (1 with embryos 9 mm) 5—9 mm. — **St. 90.** 47°47′ N, 8°00′ W. 21 (22)-6-1905. 300 m.w. 2 spec.: 1 ♂ 7 mm, 1 ♀ 7—8 mm. — **St. 47.** 45°00′ N, 2°57′ W. 17-5-1906. 300 m.w., 2^{35} pm., 120 min. 1 ♀ with ova 7 mm. — **St. 36.** 44°21′ N, 2°37′ W. 10-5-1906. 1250 m.w. 4 ♀ with embr. 7—8 mm. — **St. 168.** 58°42′ N, 6°13′ W. 2-9-1905. 65 m.w. 2 ♀ 4 mm. — **St. 74.** 49°23′ N, 12°13′ W. 10-6-1906. 2000 m.w. 11^{35} am., 60 min. 11 ♀ (5 with ova) 6—7 mm. — **St. 76.** 47°27′ N, 13°33′ W. 12-6-1906. 200 m.w., 2^{40} am., 120 min. 1 ♀ 7 mm. — **St. 76.** ibid. 2800 m.w., 3^{00} pm., 120 min. 44 spec.: 4 ♂ ad. 5—6 mm, 40 ♀ (7 with ova 5—6 mm) 4—7 mm (1 ♀ 8 mm). — **St. 181.** 49°22′ N, 12°52′ W. 4-9-1906. 1800 m.w., 60 min. 1 ♀ 5 mm. — **St. 1.** 28-11-1908. 25 m.w., 2^{50} am., 30 min. 74 spec.: 25 ♂ (ad. & jun.) 3—4 mm, 49 ♀ (3 with ova) 3—4 mm. — **St. 3.** 30-11-1908. 65 m.w., 1^{15} pm., 30 min. 1 ♀ 4 mm, 1 ♂ ad. 4 mm. — **St. 4.** 1-12-1908. 1500 m.w. 11^{45} am, 30 min. 2 spec.: 1 ♂ ad. 5.5 mm, 1 ♀ 4 mm. — **St. 70.** 4-3-1909. 65 m.w., 9^{00} am., 60 min. (6 ×) 172 spec.: 20 ♂ ad. 5—6 mm, 75 ♀ without ova 5 mm, 77 ♀ with ova (a few with embryos) 5—6 mm. — **St. 73.** 8-3-1909. 65 m.w., 3^{30} pm., 30 min. 5 spec.: 1 ♂ ad. 4 mm, 4 ♀ (1 with ova) 4—5 mm. — **St. 76.** 10-3-1909. 25 m.w., 7^{15} pm., 30 min. 45 spec.: 15 ♂ ad. 5—7 mm, 30 ♀ (9 with ova 6—8 mm) 5—9 mm. — **St. 76.** 65 m.w., 6^{05} pm., 60 min. 27 spec.: 9 ♂ ad. 6—7 mm, 18 ♀ 4—6 (7) mm (3 with ova 6 mm). — **St. 76.** 300 m.w., 11^{30} am., 60 min. Abt. 500 spec.: 200 ♂ (a few of them jun.) 5—7 mm, 300 ♀ (35 with ova) 5—6 mm. — **St. 76.** 600 m.w., 1^{15} am., 60 min. 109 spec.: 39 ♂ ad. 6—7 mm, 70 ♀ (14 with ova or embryos) 5—7 (8) mm. — **St. 76.** 1600 m.w., 2^{40} pm., 60 min. 9 spec.: 7 ♂ (1 juv.) 4—7 mm, 2 ♀ (1 with ova) 5 mm. — **St. 77.** 11-3-1909. 65 m.w., 3^{15} pm., 30 min. 42 spec.: 24 ♂ 5—6 mm (a few of them jun.; 1 spec. 8 mm), 18 ♀ (4 of them with ova or embryos 4 mm) 4—5 mm. — **St. 79.** 13-6-1910. 65 m.w., 8^{40} am., 15 min. 113 spec.: 67 ♂ (some of them jun.) 6—7 mm, 46 ♀ (5 with ova 5—6 mm) 5—7 (8) mm. — ?**St. 80.** 13-6-1910. Surf. (P. 100), 10^{05} pm.,

5 min. 5000 jun.(?), 1—1.5 mm. — ?**St. 81.** 15-6-1910. Surf. (P. 100), 4^{05} pm., 5 min. 3 jun.(?), 1—1.5 mm. — **St. 85.** 17-6-1910. Surf. (P. 100), 2^{05} am., 10 min. 15 spec.: 9 ♂ (1 jun. 4 mm) 4—5 mm, 6 ♀ (3 with ova 4—5 mm) 3—5.5 mm. — **St. 87.** 17-6-1910. 300 m.w., 4^{00} pm., 30 min. 3 ♀ 5 mm. — **St. 236.** 13-9-1910. Surf. (P. 100), 11^{15} pm., 10 min. 23 spec.: 18 ♀ 4—5.5 mm, 5 ♂ 5—7 mm. — **St. 236.** ibid. 25 m.w., 11^{00} pm., 15 min. (70 ccm = 15 ×). 220 spec.: 108 ♂ (some of them jun.), 2 ♀ with ova 6—7 mm, abt. 110 ♀ without ova 5—6 mm. — **St. 239.** 15-9-1910. 25 m.w., 5^{10} pm., 15 min. 2 ♀ 6 mm, 1 (2?) ♂ jun. 5 mm. — **St. 245.** 17-9-1910. 400 m.w., 5^{15} pm., 120 min. 1 ♂ 7 mm. — **St. 246.** 18-9-1910. 100 m.w., 8^{15} am., 15 min. 30 spec.: 9 ♂ ad. 4—5 mm, 7 ♂ jun. 4—5 mm, 14 ♀ 3—5 mm. — **St. 247.** 19-9-1910. Surf. (P. 100), 8^{40} pm., 10 min. 6 spec.: 4 ♂ ad. 4 mm, 2 ♀ 3—3.5 mm. — **St. 248.** 20-9-1910. Surf. (P. 100), 9^{30} pm., 10 min. 6 ♂ (1 jun.) 5 mm. — ?**St. 242.** 17-9-1910. Surf. (P. 100), 4^{00} am., 10 min. 200 spec. jun., 1—4 mm. — ?**St. 242.** ibid. Surf. (P. 100), 10^{25} pm., 10 min. 3 spec. jun. 1 mm.

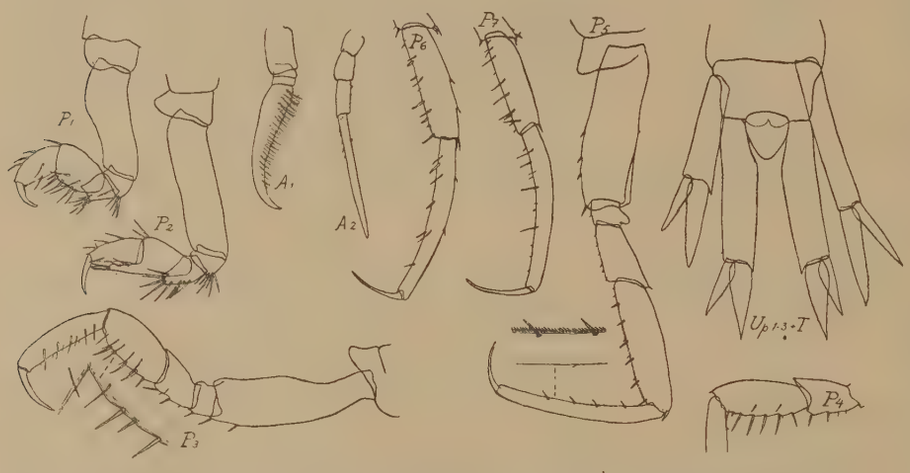

Fig. 39. *Themisto gracilipes*, the "short-legged" form. ♀ with ova 6 mm, st. 70, 1909, 65 m.w. All figures drawn to the same scale.

The greater part of the immense *Themisto*-material of the "Thor" is made up of small individuals, about 5—6 mm long, which cannot be identified either with *T. abyssorum* or *T. compressa*, but occupy an intermediary position between the two species; some few individuals indeed, come very near to *T. bispinosa*. It cannot be maintained that the deviation from the species mentioned is due to their being young individuals, for about half of those in the present material are clearly adult specimens, which appears, firstly from the long articulated antennæ and the shape of up. 1 in the male, and further from the fact that a great number of females have ova or embryos, without being larger or differing in other respects from the other specimens in the same sample.

As it has proved very difficult to determine these specimens from extant works, I will first of all give a description of the animals, and later on examine the question from a literary point of view.

The principal source of difficulty in making the determination is the extremely great variation as regards p. 5. The extremes are represented, partly by a form where p. 5 is not longer than p. 6, nor in other respects particularly deviating, so that the animals are made to resemble *T. abyssorum*, and partly by a form where p. 5 is so long that p. 6 (p. 5—p. 6 when fully straightened out) reaches only to about the proximal $^1/_4$ or $^1/_6$ of the metacarpus in p. 5, which in the most extreme cases can on the distal half be provided with a comb $^3/_4$ the breadth of metacarpus itself, in which respect the animals can easily be confused with *T. bispinosa*. The two forms are connected by numerous intermediary stages, which can easily be confused with *T. compressa*.

The two extreme forms are in the following called the short-legged and the long-legged type respectively.

A. The short-legged form (Figs. 39—40).

Probably identical with *Hyperia oblivia* Kröyer (see above p. 95).

♀ (fig. 39). Habitually bearing a strong resemblance to *T. abyssorum*; the difference between *H. oblivia* and *P. abyssorum* as regards ant. 1 and p. 3—p. 4 is given under this species (p. 96); see also the key in my paper on the "Ingolf" Amphipoda 1923, p. 19.

The size is 4—7 mm; in a very few cases 9 mm; ♀ with ova (4) 5—7 mm, rarely 8 (9) mm. On the other hand *T. abyssorum* is as a rule larger, 7—10 mm or even 17—22 mm.

The cephalon as in *T. abyss.* The mesosome along the dorsal line of the same length as the metasome + urosome. The body is slightly compressed, so that there may be an indication of a carina, particularly in the hindmost mesosome segments and the foremost metasome segments, but there are as a rule no dorsal teeth. A few specimens of the short-legged form approach *T. compressa* in having a suggestion of small teeth along the dorsum (St. 88, 1905; St. 79, 1910, 65 m.w.), but also in these specimens the carpal process in p. 2 is not

so long as the metacarpus, but only extends to about its proximal $^2/_3$, which agrees with *T. gracilipes*.

For ant. 1—2 see under *T. abyss.* p. 96. P. 1—p. 2 hardly indicate any specific difference from small individuals of 5—7 mm of *T. abyss.*; in small individuals of *T. abyss.* the upper margin of the metacarpus in p. 1—p. 2 seems to have a few more spines than in *T. gracilipes* (about 8 against 3—4), but the carpal process in p. 2 is short in both species, in *T. gracilipes* only a little over half the length of the metacarpus.

In p. 3, the carpus is ovate, with a fairly regularly curved, upper and under margin; on the under margin

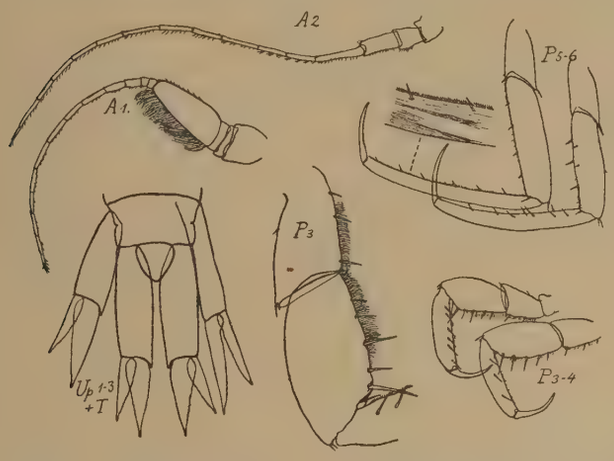

Fig. 40. *Themisto gracilipes* ♂, the "short-legged" form, st. 123, 1910, 65 mw. All figures drawn to the same scale except the details of p. 3 and p. 5.

there are some 5 rather large spines; the length is double the greatest breadth. Between the spines on the under margin of the carpus there are no fine hairs. The carpus in p. 4 is of similar shape, but more elongate; the length is between $2^1/_2$ and 3 times as great as the greatest breadth; on the under margin there are some 6 rather large spines, and at the distal end there are fine hairs between the spines. For difference from *T. abyssorum* see this species (p. 96); in other respects there does not seem to be any difference in p. 3—p. 4 between the two species.

P. 5 resembles p. 5 in *T. abyssorum*, but is slightly heavier than in specimens of a corresponding size of *T. abyss.*; there is hardly any character sufficiently pronounced to be designated as a specific difference. P. 6—p. 7 are a trifle shorter than p. 5, which is due to the fact that the carpus is a little shorter and narrower, in p. 7 only $^3/_4$ as long. As in *T. abyss.* there are small teeth on the front margin of the metacarpus in p. 5—p. 6 (not in p. 7), but the carpus and metacarpus have more and larger spines in p. 6—p. 7 than in p. 5. The dactylus in p. 7 longer than in p. 5; in p. 5 the metacarpus is $3^1/_2$ times as long as the dactylus, in p. 7 only $2^1/_2$ times as long.

The uropoda resemble up. in *P. abyssorum* of a corresponding size, but the inner rami in up. 1—2 are a little heavier in *T. gracilipes*, and there are teeth on both margins of the inner ramus in up. 3 (in small specimens of *T. abyss.* only along the inner margin). The distal end of the median margin of the peduncle in up. 2—3 terminates in a rather large tooth (considerably longer in small specimens of *T. abyss.*). The telson is $^1/_3$ the length of the peduncle in up. 3; it is nearly as broad as it is long, and the apex is rounded.

♂ (fig. 40). The size very nearly as ♀ with ova; a few adult ♂, however, are only 4 mm. ♂ is as a rule a little slenderer than ♀; besides the other sexual differences, which will be mentioned later on, it is distinguished from ♀ by p. 5, even in the most shortlegged animals, being somewhat longer than p. 5; for further particulars see below.

In the following, only the difference from ♀ are mentioned; description and fig. apply to a 5 mm male, from St. 123, 1910, 65 m. w. which seems to have the shortest p. 5 in the whole of the material.

In ant. 1, the flagellum has 13 joints; in ant. 2, which is somewhat longer than ant. 1 and of the same length as cephalon + pereion, there are also 13 joints in the flagellum. In p. 3 the carpus is distinguished from ♀ in having the under margin almost entirely straight up to the distal end, where with a sudden bend it curves upwards towards the metacarpus. The under (hind) margin of the carpus and the preceding joint is also besides the usual spines covered with fine, soft hairs. In p. 4 the shape of the carpus is as in the female, but it has the same setose covering as in p. 3 ♂. P. 5 is a little longer than p. 6, the proportion of the carpus to that in p. 6 being as 6:5; the metacarpus in p. 5 is, on the other hand, only a trifle longer than in p. 6. Up. 1—3 are as in the female, but the peduncle is a trifle shorter. The inward excavations in the opposite margins of the two rami in up. 1 are not very large, for which reason I presume that the specimen shown is not an adult. In the other specimens, up. 1—3 are a little shorter and broader, and the above-mentioned excavations on the median margins longer.

B. The long-legged form (Fig. 41).

In its most extreme form this type can easily be confused with *T. bispinosa*, in that p. 5 has a high comb on the distal $^2/_3$ of the metacarpus; it is, moreover, so long

that p. 6 does not extend to more than the proximal $^1/_4$ of the metacarpus; for the rest see below.

In the material there are not a few specimens of this form, particularly from St. 76 (1909, at all depths below the surface) and St. 236 (1910; surf. and 25 m. w.); but it is not nearly so numerous as the short-legged form. Apart from p. 5, both sexes seem to be entirely like the short-legged form; as to ♀ there is otherwise nothing to add.

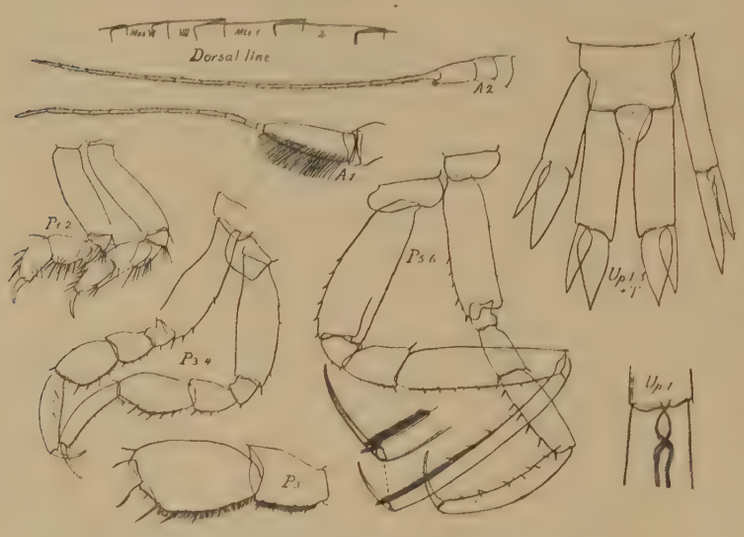

Fig. 41. *Themisto gracilipes* ♂ ad., 7 mm, the "long-legged" form. All figures drawn to the same scale except details of p. 3, p. 5 and up. 1.

♂ (fig. 41). The figures and the remarks below apply to a large male of 7 mm from St. 76, 1909; apart from p. 5 the differences between this and the short-legged ♂ of 5 mm mentioned and shown above, are as far as I can see, only due to the difference in size. The carpus in p. 3 is proportionally a little broader and with its sharp bend on the under margin it has a very characteristic form. P. 5 is so much longer than p. 6, that when both legs are straightened out, the metacarpus of p. 6 will at most extend to the proximal $^1/_4$ of the metacarpus of p. 5; this is due to the fact that both the carpus and the metacarpus of p. 5 are between $1^1/_2$ and 2 times as long as that of p. 6. The metacarpus of p. 5 has, on its front margin, besides larger and thick bristles, also a comb of teeth or spines at the distal end reaching a length corresponding to $^3/_4$ the breadth of the metacarpus.

The uropoda are a little broader and heavier than in the short-legged, somewhat smaller male described; besides there is a considerably longer excavation in the opposite margins of the rami in up. 1 than in the smaller male.

C. Intermediary forms between the short-legged and the long-legged forms. A large quantity of the material, not quite as numerous as the short-legged form, but considerably more numerous than the most extreme long-legged one, cannot be attributed to either of the above-mentioned forms, but form a continuous transition between the latter, so that the two extreme forms are not different species, but only the extreme links of a series of forms.

The specimens most nearly allied to the short-legged form have proportionally longer p. 5, but not a higher comb on the metacarpus in p. 5. The development tends in the direction of p. 5 becoming longer and longer; when it has attained proportionally the same length as in the long-legged form, the comb on the metacarpus increases in breadth, so that it becomes at last as broad as the long-legged, broad-combed form. All of these intermediary stages are represented in the material, and they are mixed in such a manner that, when one sample contains only a few animals, it is nearly always the short-legged form; in larger quantities of specimens some of the intermediary forms are represented, but only in the very large samples is the long-legged form with a high comb on p. 5 represented. There is nothing to suggest that the various forms represent different age-stages because in all of them there are adult males as well as females with ova. (The use of the word development in the above, must not be taken as meaning that the same individual commences by having a short p. 5 and later on has a long p. 5 with a high comb, but only that the above-mentioned characters may be more or less strongly developed in the various individuals.) The intermediary forms with long p. 5, but a low comb on the metacarpus can easily be confused with a small *T. compressa*, where, however, the carpus in p. 3 is considerably narrower at the distal end, and where there are more (about 10) spines on the under margin of the carpus.

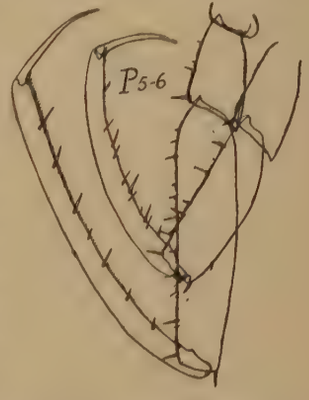

Fig. 42. *Themisto gracilipes* ♂, 5.5 mm, st. 76 (1909, 600 m.w.). Intermediate form.

The material comprises 31 (36) stations, 37 (43) hauls, about 5500 spec., besides an almost equally large quantity of young ones, too small (1—1.5 mm) for certain determination. Distributed according to sex 23 ♂, 36 ♀ were taken in the Mediterranean, and about 2150 ♂, 3300 ♀ in the Atlantic; the proportion between number of males and females is thus in both seas nearly as 2:3.

A. Mediterranean.

In this sea, from which the species has not previously been recorded with certainty (see below under Distribution) it was found at 7 stations, 7 hauls, 59 spec. in all. The stations are distributed over the whole of the Mediterranean, as far as into the eastern region: 2 stations lie east of the Strait of Gibraltar, 1 in the Bay of Genova, 1 in Tarento Bay, 1 in the southern part of the Adriatic, and 2 in the Bay of Piræus. The depth of the sea is between < 100 m and 2000 m. The specimens were taken at all seasons and the greater number with a length of wire of 65—300 m, but no difference is to be seen between the depths during the night and the day respectively. Females with ova were found both in April, June, August and December.

B. Atlantic.

The species was taken here at 24 (29) stations, 30 (36) hauls in all; number of specimens about 5400. The distribution according to months is as shown in the summary below.

	stations	hauls	specimens
June 1905	2	2	5
Sept. —	1	1	2
May 1906	2	2	5
June —	2	3	56
Sept. —	1	1	1
Nov. 1908	2	2	76
Dec. —	1	1	2
March 1909	4	8	abt. 1750
June 1910	3	3	131
Sept. —	6	7	3399
Total...	24	30	abt. 5400

Depth of the sea and occurrence.

Depths in m	Total no. of posit. stations	Posit. stations of the "Thor" 1908—10
0— 500 m	13	12
> 500—1000 -	2	—
> 1000—2000 -	7	2
> 2000—3000 -	1	—
> 3000 -	1	1
Total...	24	15

From this it appears that of the 15 positive stations in 1908—10 12 are at depths of 0—500 m, 11 even at depths answering to 94—180 m and only 1 station (st. 245) at 330—460 m.

The species was taken all the way from the Bay of Cadiz along the coast of Portugal, across the Bay of Biscay as far as the Channel, and South-west Ireland, and also in two localities (St. 74 and 168, 1905) west of Scotland. Here it meets the *T. abyssorum*, which supplants it in the northern waters.

For information to be found in extant literature see below under Distribution.

Vertical Occurrence.

Depth 0—500 m. (1908—10).

	No. of hauls		No. of spec.	
	Night	Day	Night	Day
10— 25 m. w.	5	1	3409	3
65—100 —	—	6	—	860
150—250 —	—	—	—	—
[illegible] —	—	1	—	1

The subjoined table, comprising only hauls from depths of 0—500 m, shows that during the night the species was only taken close to the surface (at most 25 m. w.), during the day almost exclusively with 65—100 m. w. It occurs both in shoals and sporadically.

Propagation. North of 40° N. females with ova or embryos were found in March, May, June and Novbr., and South of 40° N. in March, June and Sept.; it thus seems to propagate at least in the northern area all the year round.

One female from St. 76, 1909, 25 m. w. (6 mm, fairly long p. 5, with a low comb), which had the whole of its marsupium full of ova, apparently without having lost a single one, had 37 ova, 0.6—0.7 mm in diameter.

Literature and synonymy.

On account of its very varying appearance, which makes it resemble no fewer than 3 different species, and the lack of any really good description or figure in extant literature, this species has given rise to much confusion.

Nevertheless there can not be much doubt that the species in question is *Euthemisto gracilipes* Norman.

From the short original descriptions given by Norman, especially Norman & Scott 1906, and Brady & Norman 1909, we learn that it very nearly approaches *Euthemisto compressa* "in the form of the carpus of the

two first pairs of legs and other particulars. The obvious differences are the total absence of any sign of the dorsal spination characteristic of *E. compressa* Goës, and its very small size (we have not seen any specimens that exceeded 6 mm length)" (Norman & Scott 1906, p. 54). "Although we have given it as a species, we really regard it as a depauperized form of *E. compressa*" (Brady & Norman 1909, p. 301). (Norman 1909 [The Celtic Province], p. 26, note, changes the name into *E. compressa* var. *gracilipes*). — "British writers, following the mistake of Bate & Westwood, have frequently recorded it as *Parathemisto oblivia*. From that species it may at once be distinguished by the carpus of the first two pairs of peræopods, which are ovately formed, and wider than the preceeding joint." (Brady & Norman 1909, p. 301). — The form described above must be that noted in the foregoing as the short-legged form.

The real *T. gracilipes* doubtless has not infrequently been determined in extant works as the species, which it may resemble in its various forms, *viz. T. abyssorum* Boeck and *T. compressa* Goës (= *T. bispinosa* Boeck) though of course this cannot always be demonstrated in each indicidual case from the literature alone. A good deal of light has been thrown on the confusion by the item of information given by Tesch (l. c. 1911, p. 185) as to the Bulletins of the International Marine Investigations. In not a few cases we find remarks of a morphological or biological character, and these can at times — at any rate to some extent — give valuable hints as to the question of species. For *T. abyssorum* Boeck and its relation to the present species see above.

Below will be given an examination of the literature which in my opinion ought to be referred to this species.

Hyperia oblivia Kr. 1838 (♀) is probably the present species (and not *T. abyssorum* Boeck), which in particular is evident from the strongly curved ant. 1 (Kröyer l. c., Pl. 4 fig. 19 a) and the oval carpus in p. 3 (ibid. fig. 19 c). That it is the short-legged form appears from the statement that p. 5—p. 7 are "inter se nearly of the same length" (Kröyer gives no figure of this). Kröyer's figure of uropoda (l. c. fig. 19 f) contains various mistakes, the greatest being that up. 1 has been made shorter than up. 2.

On Edward 1867, Sp. Bate & Westwood 1868, Scott 1891 and Norman 1900, see Tesch 1911, p. 184—185.

Norman l. c. 1869 mentions firstly *H. oblivia* Kr. (non B. & W.) which he characterizes among other things by p. 5—p. 7 having "the whole hinder edge of the propodos microscopically pectinate", and also *H. oblivia* B. & W. (non Kr.) which, on account of B. & W.'s erroneous statement of the form of p. 2, he proposes to call *H. gracilipes*, and thus this name was introduced into the literature. (It can hardly be considered out of the question that his "*H. oblivia* Kr." is in reality *Parath. abyssorum* Boeck).

Bovallius l. c. 1887 refers *H. oblivia* Bate to genus *Parathemisto*, and calls it at the same time *P. longipes* n. sp., from which it seems evident that he was not acquainted with Norman 1869. In 1889 he changes the name into *P. gracilipes*.

Euthemisto Gaudichaudii Stebbing 1888 is perhaps the present species, but has been taken in the South Sea.

Fowler l. c. 1898 examines "*T. abyssorum* Boeck" from biological points of view, and arrives at the conclusion that it can be divided into a larger form (7—10—17 mm) living over great depths of the sea in the more northern waters, and a smaller form (3—5 mm) which is encountered at shallower depths towards the south (British coasts). I now consider it an absolutely foregone conclusion, partly on the strength of the list of literature given by Fowler, and partly by comparisons with the biological results from the "Thor", that the larger northern form of Fowler (Fowler l. c. p. 583—584, § I—III) is *T. abyssorum* Boeck, whereas the small form from shallower depths (Fowler ibid. § IV) is *T. gracilipes*. *P. oblivia* Walker 1903 is, on account of the locality, undoubtedly *T. gracilipes*, and the same holds good for Chevreux 1900 and 1913 and Stewart 1913, perhaps also partly for Stebbing 1904.

What Tattersall 1906 p. 24 mentions under the name of *Euth. compressa*, also comprises *T. gracilipes* (note ibid. p. 36) which, however, Tattersall only considers a juvenile form of *T. compressa*. What T. calls *P. oblivia* undoubtedly also includes *T. gracilipes*.

Steuer l. c. 1911 says that *T. compressa* "scheint der häufigste Planktonamphipod der Adria zu sein;" the size is given as 7.5—8 mm at the most. On the strength of the "Thor" material I consider it exceedingly probable that the species in question is really *T. gracilipes*.

Tesch 1911 gives a short summary of the fate of the name *Euth. gracilipes* in the literature. To this species must, however, also be reckoned part of the material, which he records, partly under *Euth. compressa*, partly under *P. oblivia*. As to Tesch's chart of the distribution see below under "Distribution".

Apart from Tesch 1911, no attention has been paid to the statements of the International Marine Investigation as regards the species in question [Publications de circonstance No. 33 (1906), No. 48 (1909), No. 70 (1916)], for the determinations are, at any rate as far as the Danish material is concerned, not reliable (O. Paulsen,

Meddel. Komm. Havundersøg., Plankton vol. 1, No. 9, 1909, p. 53).

As to TESCH 1915 there is nothing to add beyond the fact that "*T. oblivia*" undoubtedly does not comprise BOECK's species.

Distribution and biology.

For the "Thor", see above.

?Greenland (KRÖYER 1838) see above p. 102.

1. The waters on both sides of the British Isles. "Shallow waters round our coasts": Banff (Moray Firth), Forth, Clyde, St. Andrews (between Leith and Dundee), Valentia, Galley Head (Co. Cork) (FOWLER l. c. 1898, p. 584 § IV). — ?Shetland (NORMAN 1869). — Moray Firth (BATE & WESTW.). — Largo Bay (Firth of Forth) (SCOTT 1891). — Devon and Cornwall, at all seasons; W of Scotland (NORMAN & SCOTT 1906). — 52°7.5′ N, 11°20.1′ W, surf., 20 fath., 50 fath. several young, the largest being 7 mm long (WALKER 1903). — Redcar, North Yorkshire (NORMAN 1909). — Northumberland, different localities (BRADY & NORMAN 1909). — Southern W. Ireland, shallow water, at all seasons (TATTERSALL 1906). — North sea 27 (39) stations, 16—80 m. Jan. 25—May 13 (TESCH 1915).

2. Bay of Biscay: without locality (?STEBBING 1904 and CHEVREUX 1900, surf. (night) and 494 m (day).) — ?The west coast of France between Pen March or Ile de Sein (south of Brest) and Spain, 50—90 m below the surf. (CHEVREUX 1900 and 1913).

3. Bay of Cadiz 39° N, 10° W, a few spec. 3—4 mm (in the Copenhagen Zool. Museum).

4. ?Southern Atlantic. 15°45½′ S, 33°11½′ W, 1 ♀ 3.5 mm, determination not certain (STEWART 1913).

5. Mediterranean. Beaulieu (between Nizza and Monaco) 0—50 m (CHEVREUX 1913). — ?Adriatic. (STEUER 1911). —

If the above list of distribution, which agrees in a striking degree with the collections of the "Thor", is correct, the chart of the distribution given by TESCH (l. c. 1911, Pl. XXV) is incorrect, as it extends too far towards North and East.

It must undoubtedly be considered a small southern shallow water form (esp. on 0—200 m) of *T. abyssorum* (FOWLER 1898) or *T. compressa* (NORMAN & SCOTT 1906, NORMAN 1909) and forms a connecting link between the two species. It is probably a good species.

The statements contained in the works of several writers that it may at times occur in immense quantities agrees well with the results of the "Thor" (TATTERSALL 1906, BRADY & NORMAN 1909); indeed, it may at times be washed ashore in such quantities as to form an actual wall (NORMAN 1909, BRADY & NORMAN 1909).

According to BRADY & NORMAN, the specimens found off the northern part of the east coast of Great Britain must have been carried thither by a current coming from the North. This agrees well with the fact that the species has never been found in the middle regions of the North Sea; the specimens to be found in the southern regions (TESCH 1915) or in the Channel ("Thor") have thus been brought there from the south.

Symbiosis. NORMAN l. c. 1869 mentions a female found in *Aurelia*; but perhaps it is *T. abyssorum*.

3. THEMISTO COMPRESSA Goës.

(= *Themisto compressa* Goës + *Th. bispinosa* Boeck).

As it appears from the literature (see the historical summary in VOSSELER 1901, pp. 81—83) there are very different opinions as to whether *Themisto compressa* and *T. bispinosa* are one or two species. Since they were first distinguished by STEBBING, (1888) however, and SARS (1895) all modern authors (with the exception of BOVALLIUS 1889) seem to consider them two species.

The fact that both of the above-mentioned authors only had a few specimens at their disposal has made the matter appear simpler than it really is, as will also be seen from the work of VOSSELER; the figures of SARS of both "species" present extreme forms, and my material shows clearly that the specific characters are by no means always so strongly developed as represented in SARS' figures.

In 1887 p. 59—60 H. J. HANSEN mentions intermediary forms, for which reason he considers them synonymous; he is of opinion that *T. compressa* is the young, *T. bispinosa* the older individual, which, however, is no more correct than the opinion of BOVALLIUS (Monograph) that *T. compressa* is ♀, *T. bispinosa* ♂, for in the material at my disposal there are great quantities of ♂ and ♀ among typically developed individuals of both "species". In the "Thor" material also I have now found intermediary forms which, though adult, can neither be ascribed to the one nor the other species, but combine the characters of both; it is thus an established fact that they are in reality one species.

VOSSELER's summary of the specific differences (l. c. p. 83) is in some points not a happy one. In *T. compressa* the thorax (pereion) is said to be longer than the pleon, in *T. bispinosa* shorter; in all the specimens I have measured, the pereion is longer than the pleon in both "species". Further, the cephalon in *T. compressa* is said to be shorter, in *T. bispinosa* longer than the following

3 segments. This ought to be corrected to the following: in *T. compressa* the pereion is of the same length as the 3 first pleon segments, in *T. bispinosa* corresponding in length to about $3^1/_2$—4 first segments. In *T. compressa* the under margin of the carpus in p. 3 is fairly regularly curved, in *T. bispinosa* on the other hand, the greatest breadth is proximal in relation to the middle.

The comb on the metacarpus in p. 5 is in *T. bispinosa* not infrequently as broad as the metacarpus itself; it is almost entirely absent in the proximal half. The dactylus always extends beyond the comb and is at least twice as long as the breadth of the metacarpus + comb. In *T. compressa* there is no comb, but only a row of fine teeth or spines. In both "species" the epimeral part of p. 5—p. 6 (1. joint) is provided with a process near the under margin; in this manner two rather large teeth appear on either side of the animal (see fig. 47, p. 108[1]). Vosseler's specimens differ both from my specimens and, as far as I know, from all those mentioned in the literature, by frequently having the peduncle in up. 1 longer than in up. 2, whereas it is generally shorter.

Both "species" have teeth along the dorsal line, in particular on 6.—7. mesosome segment and 1. metasome segment, but on the immediately preceding and the immediately succeeding segment a suggestion of a tooth may be found. My figure (fig. 43) represents *T. bispinosa*, but the teeth have almost the same development as in *T. compressa*. The first suggestion of teeth comes as a rule when the animals are about 9 mm long, but they are rarely quite distinct in individuals of less than 10—11 mm. In large individuals they are as rule very large and (often) with a strong upward bend.

Vosseler (l. c. p. 82) is right in saying that during their growth no essential change takes place in the two "species" (except as regards the dorsal teeth, which are not mentioned), as individuals of about 5 mm have already fully developed specific characters. This agrees extremely well with the "Thor" material; much greater variety is possible among individuals of the same size than between small and large specimens.

[1] Shortly before this work was ready for press my attention was drawn to the fact that Chevreux 1911 (Bull. Inst. Océanogr. Monaco, No. 204, p. 13) had already observed the same in a *T. compressa* female with ova, 23 mm, from the Bay of Biscay. He says that these processes are not to be found on Norwegian specimens, which, it is true, do not exceed 12 mm, and are thus only about half as large as the specimen in question. In consequence of this remark I have examined specimens from various regions of the North Atlantic, and all specimens exceeding 8—9 mm have these processes, but they are greatest and most pronounced in large individuals. It thus seems as if they develope fairly simultaneously and together with the dorsal teeth.

Vosseler is also right in saying that there is no great sexual difference; but there are differences also in other respects than as regards the length of the antennæ (see the two "species" separately).

Though it must be considered an absolute fact that the two "species" are in reality only one; they will, for

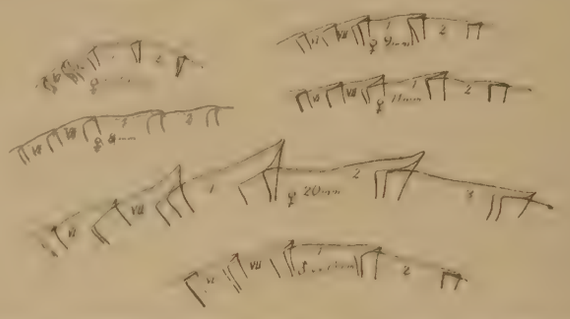

Fig. 43. *Themisto bispinosa*, dorsal line of some of the segments of specimens of different sizes (7.5—20 mm). All figures drawn to the same scale. VI—VII: 6.—7. mesosome segments. 1—3: 1.—3. metasome segments.

clearness' sake, be treated separately, first on the strength of the material of the "Thor", secondly as regards literature and synonymy, and last of all the intermediary forms will be dealt with. I propose to call them *Th. compressa* Goës forma *compressa* n. n. and *Th. compressa* Goës forma *bispinosa* Boeck n. n. respectively.

3 A. THEMISTO COMPRESSA Goës forma COMPRESSA Goës (K. St.) (Figs. 45—46).

Themisto compressa forma *compressa* K. Stephensen 1923, p. 27 (lit.). — ??*Euthemisto Thomsoni* Stebbing 1888, p. 1414, Pls. 174—75.

[Mediterranean.

St. 18. 30-12-1908. 300 m.w., 9[30] pm.(?), 60 min.(?). 1 ♀ jun. 8 mm.]

Atlantic.

?**St. 90.** 47°47′ N, 8°00′ W. 21 (22)-6-1905. 300 m.w. 7 ♀ (1 with embryos) 6–8 mm. — **St. 124.** 61°04′ N, 4°33′ W. 23-7-1905. 1000 m.w. 2 ♀ 11 mm. — **St. 162.** 63°42′ N, 13°02′ W. 27-8-1905. 65 m.w. 3 ♀ (1 with ova) 7—10 mm. — **St. 164.** 61°21′ N, 11°00′ W. 29-8-1905. 65 m.w. 2 ♀ 12—14mm. — **St. 179.** 47°20′ N, 12°23′ W. 3-9-1906. 300 m.w. 1 ♀ 13 mm. — ?**St. 1.** 28-11-1908. 25 m.w., 2[30] am., 30 min. 1 ♀ jun.? 6 mm. — **St. 73.** 8-3-1909. 65 m.w., 3[30] pm., 30 min. 14 spec.: 10 ♂ ad. 8—9 mm, 4 ♀ with ova 9—11 mm. — **St. 74.** 9-3-1909. 65 m.w., 1[30] am., 60 min. 1 ♀ with ova 20 mm. — **St. 74.** ibid. 300 m.w., 10[30] pm., 60 min. 35 spec.: 15 ♂ ad. 16—18 mm, 20 ♀ 18–22 mm (4 with ova 19 mm). — **St. 74.** ibid. 600 m.w., 0[30] am., 60 min. 7 ♂ ad. 16—19 mm. — **St. 75.** 9-3-1909. 65 m.w., 9[30] pm., 60 min. 2 spec.: 1 ♂ ad. 21 mm, 1 ♀ with ova 21 mm. — **St. 75.** ibid. 300 m.w., 7[45] pm., 60 min. 32 spec.:

17 ♂ ad. 17—22 mm, 1 ♂ juv. 16 mm, 3 ♀ with ova or embryos 18—22 mm, 11 ♀ without ova 17—20 mm. — **St. 75.** ibid. 600 m.w., 6^{30} pm., 60 min. 3 spec.: 2 ♂ 18—19 mm, 1 ♀ 19 mm. — **St. 76.** 10-3-1909. 25 m.w., 7^{15} pm., 30 min. 2 ♂ (1 ad., 1 jun.) 12 mm. — **St. 76.** ibid. 300 m.w., 11^{30} am., 60 min. 6 spec. 9—10 mm: 4 ♂ jun., 2 ♀. — **St. 80.** 13-6-1910. 25 m.w., 10^{45} pm., 15 min. 3 ♀ (1 with ova 14 mm) 12—14 mm. **St. 80.** ibid. 65 m.w., 10^{00} pm., 30 min. 7 ♀ 10—14 mm. — **St. 80.** ibid. 300 m.w., 10^{05} pm., 30 min. 168 spec.: 45 ♂ ad. 10—14 mm, 6 ♂ jun. 12 mm, 117 ♀ (3 with ova 11—13 mm) 11—15 mm. — **St. 81.** 15-6-1910. 300 m.w., 10^{05} pm., 30 min. 75 spec.: 66 ♂ ad. (9)10—14 mm, 4 ♀ 7—7.5 mm, 4 ♀ 11—15 mm, 1 ♀ with great embryos 12 mm. — **St. 81.** ibid. 500 m.w. (5^{00} pm.?) 8 ♂ ad. 11—13 mm. — **St. 240.** 15-9-1910. 300 m.w., 9^{00} pm., 15 min. 4 spec.: 2 ♂ ad. 12—16 mm, 2 ♀ with ova 18.5—20 mm. — **St. 240.** ibid. 1000 m.w., 9^{40} pm., 30 min. 3 spec.: 2 ♂ ad. 12—14 mm, 1 ♀ 17 mm. — **St. 242.** 16-9-1910. 4350 m.w. (Y. 330), 7^{00} pm., 60 min. 10 spec.: 1 ♂ jun. 14 mm, 9 ♀ (4 with ova 16—21 mm) 16—21 mm. — **St. 244.** 17-9-1910. 1000 m.w., 10^{35} am., 30 min. 13 spec.: (3 ♀ 7—10 mm?), 3 ♀ 13—14 mm, 1 ♀ 17 mm, 4 ♀ with ova 16—19 mm, 2 ♂ ad. 8—12 mm. — **St. 245.** 17-9-1910. 65 m.w., 9^{55} pm., 15 min. 4 spec.: 2 ♂ ad. 14—16 mm, 1 ♂ jun. 13 mm, 1 ♀ 16 mm. — **St. 245.** ibid. 150 m.w., 8^{55} pm., 15 min. 22 spec.: 1 ♂ ad. 10 mm, 4 ♂ ad. 15—18 mm, 6 ♀ with ova or embryos 16—19 mm, 3 ♀ without ova 8—13 mm, 8 ♀ without ova 16—18 mm. — **St. 245.** ibid. 182 m. 250 m.w., 4^{30} pm., 30 min. 5 spec.: 3 ♀ 8—11 mm, 2 ♀ 15—17 mm. — **St. 245.** ibid. 300 m. 400 m.w., 5^{15} pm., 120 min. 83 spec.: 35 ♂ ad. 12—18 mm, 2 ♂ ad. 9—10 mm, 7 ♀ with ova 17—21 mm, 2 ♀ 12 mm, 37 ♀ 15—22 mm. — **St. 269.** 46°44′ N, 11°20′ W. 24-3-1911. 47 m.w. (S. 100), 7^{30} pm., 30 min. 1 ♀ 21 mm.

The material contains in all 507 specimens (220 ♂ ad. 14 ♂ juv., 43 ♀ with ova and 230 ♀ without ova) from 16 stations, 27 hauls; only 1 spec. is from the Mediterranean, all the others from the Atlantic.

As regards the individuals themselves there is not much to be added (as to size see below). On an average they agree well with the descriptions and figures given by Sars and Vosseler (l. c.).

The specimens noted in the above lists are fairly typical, but a few deviations are found in some of the specimens.

St. 80, 1910 with 300 m. w. yielded 3 large females (12, 12 and 15 mm) (fig. 44 represents the largest ♀) in which p. 5 is hardly longer than p. 6, and the carpus in p. 3—p. 4 forms a transition to the form in *T. gracilipes*. If there had been no teeth along the dorsal line and on the epimeral parts of p. 5—p. 6, these specimens must, if anything, rather be determined as *T. gracilipes*. The same applies by the way, to the smallest ♀ with ova (16 mm) from St. 242.

A large female with ova (20 mm?, defective) from St. 245, 1910, 150 m. w. like ♂ juv. has an articulated flagellum in ant. 1.

In the one ♂ from St. 81, 1910, 500 m. w. the carpus in p. 3 is far too broad, but p. 5 is typical.

Mediterranean.

Occurence. Only 1 spec. (1 ♀ juv. 8 mm) is on record as having been taken by the "Thor" in the Mediterranean (the Bay of Piræus), and the form *bispinosa* was also taken in the same haul. As the species has

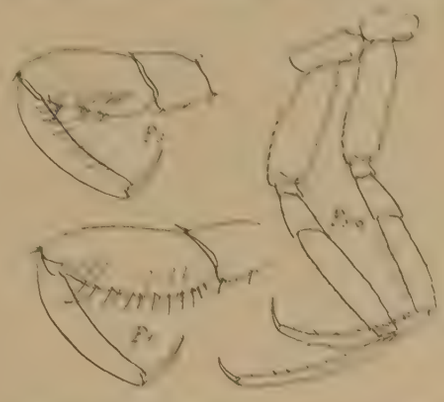

Fig. 44. *Themisto* (*compressa*?) ♀, 15 mm, st. 80, 1910, 300 m.w.

not been taken for certain in the Mediterranean, and as it is a northerly species, everything points towards a mistake in the label of locality; for the determination is sure enough. Of previous writers, only Stebbing (1911)[1] notes the species from the Mediterranean, but his specimens are probably in reality *P. gracilipes* (see this species, p. 102).]

Atlantic.

Occurrence. All the positive stations of the "Thor" lie either to the north of the British Isles (1905: St. 124, 162, 164) or in the Bay of Biscay; St. 81, 1910, however, lies off the coast of Portugal.

The depth of the sea is as shown in the subjoined table; it thus chiefly occurs in depths > 1000 m. Only 2 stations have depths < 500 m (180 and 182—450 m).

Depth of the sea	No. of stations
0— 500 m	2
>500—1000 -	2
> 1000—2000 -	4
> 2000—3000 -	2
> 3000 -	5
Total. . .	15

The species occurs for the most part rather sporadically, so that only few individuals have been taken at a time; sometimes, however, it occurs in shoals, e. g. St. 80, 1910, 300 m. w. which yielded 168 spec.; St. 87, 1910, 300 m. w.: 75 spec.; St. 245, 1910, 400 m. w.: 83 spec.

[1] For recent finds in the Adriatic see Pesta 1920, pp. 32—33.

Vertical occurrence.

m. w.	No. of hauls		
	Night	Day	(N.+D. Day?)
0— 47	3	—	—
65—150	5	1	2
250—400	5	3	1
500—600	2	—	1
> 1000	2	1	1
Total...	17	5	5

As shown by the table, the species has been taken at night from the surface down to the very deep water layers >1000 m. w., chiefly with 65—400 m. w.; in the day, on the other hand, only with a length of line of at least 65 m. w., most often 300 m. w.

m. w.	No. of spec.		Average no. of spec. per haul	
	Night	Day	Night	Day
0—47	6	—	2	
65—150	36	14	7	14
250—400	314	94	63	31
500—600	10	—	5	—
Total...	366	108	—	—

The greatest numbers per haul were taken during the night at a rather great depth, 250—400 m. w. and during the day at the same depth; but these figures perhaps do not mean very much in a species like this which occurs both in few specimens and in shoals; it is individual hauls, which have yielded the high figures.

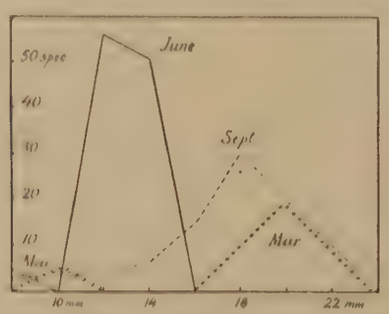

Fig. 45. *Themisto compressa* f. *compressa*, Sizes of ♀.

Size and propagation.

♂ and ♀ are of equal size, up to 22 mm. Specimens were (with a few exceptions) only taken in March, June and September.

♂ jun. Only a few (14) ♂ jun. were secured; the sizes were 9—16 mm.

♂ ad. In March there are two maxima, at 11—12 and 17—18 mm; in June the maximum lies at 11—14 mm, in Sept. at 13—18 mm. For explanation see under ♀.

♀. In March there are some few specimens 9—12 mm; all the other are 17—22 mm with a maximum at 19—20 mm. Abt. 30 % (13 out of 43 spec.) have ova.

In June only 3—4 % (5 out of totally 136) have ova; the sizes are 7—16 mm (spec. with ova 11—14 mm) with maximum of specimens at 11—14 mm.

In Sept. there are abt. 27 % with ova (23 out of totally 84 spec.); the maxima both for ♀ with ova and without ova lie at 17—18 mm.

Thus we learn that the ♀ without ova are very rarely larger than ♀ with ova. The maxima for ♀ with ova lie in March at (9—10 and) 19—20 mm, in June at 11—14 mm and in Sept. at 17—18 mm. When we remember that hardly any of the specimens have ova in June (only 3—4 %), but 27—30 % are found ovigerous in March and Sept. the spawning time may be spring and autumn (and possibly winter; but we have no hauls from this season). It seems evident, then, that the individuals which were small in the spring of 1909 were born in the autumn of 1908 whereas the large specimens were born in spring of 1908, and the latter then die in the course of the early summer so that they would have succumbed before June 1909.

What is said above as to the ♀ would also apply to ♂ as they have quite similar maxima to the ♀.

Literature and synonymy.

With the exception that the two "species" *T. compressa* and *T. bispinosa* ought to be considered synonymous we can on the whole subscribe to the view set forth by Vosseler (1901, p. 81—83, 86) as to the species of the family and the literature.

Vosseler maintains that the genus *Euthemisto* in reality hardly numbers more than 3 species *viz. E. libellula, E. compressa* and *E. bispinosa*; the others are only synonyms, perhaps with the exception of *E. australis* Stebbing, the position of which is uncertain.

Vosseler's statements, however, require a few supplementary remarks.

Lestrigonus (*Hyperia*) *spinidorsalis* Sp. Bate (Ann. Mag. Nat. Hist. ser. 5, vol. 1, 1878, p. 411, fig. 2) is on account of its dorsal teeth and its short p. 5 (not longer than p. 6) indubitably *T. compressa*, not *T. bispinosa*; the other species are, from the locality alone (Aberdeen) quite out of the question.

T. Gaudichaudi Stebbing (1888, Pls. 172—73) must

no doubt, as far as regards the two forms shown (Stebbing l. c. Pl. 172—173) be determined as *T. bispinosa*, not *T. compressa*; however, it is by no means quite out of the question that the younger specimen (Pl. 173) is *T. gracilipes* (see this species p. 102).

T. Thomsoni Stebbing 1888 is, as far as I know, an intermediary form between *T. compr.* and *T. bisp.* (see later on p. 110).

Distribution.

[Mediterranean, see above.]

Atlantic. The species is very common in the temperate regions of the Northern Atlantic, especially from abt. (40°) 50° N to the ridge from Scotland to Greenland, but it is also found at a few localities in the Southern Atlantic. For special localities see my paper 1923, p. 27, with chart.

3 B. THEMISTO COMPRESSA Goës forma BISPINOSA (Figs. 46—48).

Themisto compressa Goës forma *bispinosa* Boeck (K. St.), K. Stephensen 1923, p. 31 (lit.). — ?*Euthemisto Gaudichaudii* Stebbing 1888, p. 1410, Pl. 172. — ?*E. G.* Guérin, Bovallius 1889, p. 299 (lit. and syn.), Pl. 13 figs. 44—46. — ?*E. antarctica* Dana, Bovallius 1889, p. 294 (lit. and syn.). — ?*E. Thomsoni* Stebbing 1888, p. 1414, Pls. 174—175.

[**Mediterranean.**

St. 18. 30-12-1908. 300 m.w., 9^{30} (pm?), (60 min.?). 8 spec.: 2 ♂ (1 jun.) 5.5—6 mm, 6 ♀ (3 with ova or embryos) 6—8 mm.]

Atlantic.

St. 90. 740—1600 m. 47°47′ N, 8°00′ W. 21(22)-6-1905. 300 m.w. 1 ♀ 9 mm. — **St. 124.** 61°04′ N, 4°33′ W. 23-7-1905. 1000 m.w. 4 ♀ 15—17 mm. — **St. 162.** 63°42′ N, 13°02′ W. 27-8-1905. 65 m.w. 4 ♀: 5, 6, 8, 10 mm. — **St. 73.** 8-3-1909. 65 m.w., 3^{30} pm., 30 min. 2 ♀ 8—12 mm. — **St. 74.** 8-3-1909. 300 m.w., 10^{50} pm., 60 min. 6 ♀ 18—20 mm. — **St. 74.** ibid. 600 m.w., 0^{10} am., 60 min. 1 ♀ 19 mm. — **St. 75.** 9-3-1909. 25 m.w., 10^{15} pm., 30 min. 1 ♀ 8 mm. — **St. 75.** ibid. 65 m.w., 9^{00} pm., 60 min. 46 spec.: 1 ♂ 16 mm, 1 ♂ jun. 13 mm, 1 ♀ 22 mm, 1 ♀ with ova 20 mm, 2 ♀ 15—19 mm, 1 ♀ 12 mm, 39 spec. jun. 7—9 mm. — **St. 75.** ibid. 300 m.w. 7^{45} pm., 60 min. 12 spec.: 3 ♂ 16—19 mm, 7 ♀ (1 with embryos 18 mm) 18—21 mm, 2 ♀ 9—10 mm. — **St. 75.** ibid. 600 m.w. 6^{30} pm., 60 min. 14 spec.: 2 ♂ ad. 18—21 mm, 3 ♂ jun. 14—19 mm, 9 ♀ 18—21 mm. — **St. 75.** ibid. 4300 m.w., 1^{45} pm., 120 min. 7 spec.: 2 ♂ ad. 18—19 mm, 1 ♂ jun. 13 mm, 4 ♀ 17—19 mm. — **St. 76.** 10-3-1909. 25 m.w., 7^{15} pm., 30 min. 45 spec.: 7 ♂ juv. 10—16 mm, 38 ♀ 5—12 mm (+ ?4 ♂ jun. 8—9 mm). — **St. 76.** ibid. 65 m.w., 6^{05} pm., 60 min. 20 spec.: 6 ♂ jun. 9—11 mm, 14 ♀ 5—9 mm (1 ♀ with ova 7 mm). — **St. 76.** ibid. 300 m.w., 11^{30} am., 60 min. 35 spec.: 2 ♂ jun. 8—9 mm, 1 ♀ with ova 6 mm, 32 ♀ 6—9 mm. — **St. 76.** ibid. 600 m.w., 1^{15} am., 60 min. 27 ♀ 5—7 mm. — **St. 76.** ibid. 1600 m.w. 2^{40} pm., 60 min. 8 ♀ 5—6 mm. — **St. 77.** 11-3-1909. 65 m.w., 3^{15} pm., 30 min. 1 ♀ 5 mm. — **St. 79.** 13-6-1910. 65 m.w., 8^{40} am., 15 min. 1 ♀ 7 mm. — **St. 80.** 13-6-1910. 300 m.w., 10^{05} pm., 30 min. 4 ♀ (1 spec. 8 mm, 3 spec. 12—15 mm). — **St. 81.** 15-6-1910. 300 m.w., 10^{05} pm., 30 min. 40 spec.: 7 ♂ jun. 10—12 mm, 9 ♀ 7—9 mm, 24 ♀ 10—16 mm. (7 of them with ova 13—16 mm). — **St. 81.** 500 m.w. (5^{00} pm.?). 18 spec.: 2 ♂ jun. 10—11 mm, 2 ♀ with ova 10—11 mm, 14 ♀ without ova 9—12 mm. — **St. 236.** 13-9-1910. 25 m.w., 11^{00} pm., 15 min. (15×) 4 spec.: 1 ♂ jun. 6 mm, 3 ♀ 7—8 mm. — **St. 245.** 17-9-1910. 65 m.w., 9^{55} pm., 15 min. 1 ♀ with ova 6 mm. — **St. 245.** ibid. 150 m.w., 8^{55} pm., 15 min. 1 ♀ with ova 9 mm. — **St. 245.** ibid. 250 m.w., 4^{20} pm., 30 min. 2 ♀ 5—6 mm. — **St. 245.** ibid. 400 m.w., 5^{15} pm., 120 min. 1 ♀ with ova, 6 mm.

The material contains in all 347 spec. (9 ♂ ad., 46 ♂ jun., 18 ♀ with ova), 274 ♀ without ova, from 14 stations, 26 hauls. As regards the difference from *T. compressa* Goës forma *compressa* see above p. 103; for intermediary forms between the two "species" see below on p. 109.

The specimens noted in the above list of localities are all rather typical; the only slightly deviating specimens are the 8 which (no doubt by mistake) have been noted from the Mediterranean (St. 18), the carpus in p. 3—p. 4 being a little too narrow, but p. 5 rather typical; on a female, 7 mm from St. 236, 1910, 25 m. w. (fig. 46) the carpus in p. 3 is far too broad.

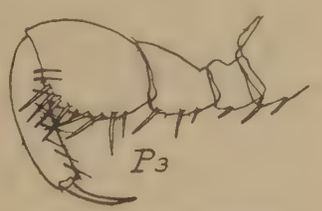

Fig. 46. *Themisto bispinosa*, ♀ 7 mm, st. 236, 1910, 25 m.w.

Sexual difference. Vosseler says (l. c.) that there is no essential difference between the sexes; this is, however, only partly correct.

The cephalon in ♂ is as a rule nearly as long as the 4 first body segments, in ♀ nearly of the same length as the first $3^1/_2$. As regards the antennæ in ♀ see Sars 1895; in ♂ on the other hand ant. 1 is nearly as long as the cephalon + the 5 first body segments and has about 17 joints in the flagellum, whereas ant. 2 corresponds to the cephalon + all 7 mesosome segments and has about 27 joints in the flagellum. For the metacarpus in p. 5 see above under *T. compressa* forma *compressa*.

The uropoda (fig. 47) agree better with Sars' figure than with that of Vosseler (l. c. fig. 10, not fig. 17, for in Vosseler's explanation of figures *E. bispinosa* and *E. compressa* have been exchanged). In the male, both of the rami in up. 1 have, at the proximal end of the median margin a large excavation, which is absent in

the female; otherwise there does not seem to be any sexual difference in the 3 pairs of uropoda. All 3 pairs are finely serrated on the median margin of the rami, smooth on the outer margins.

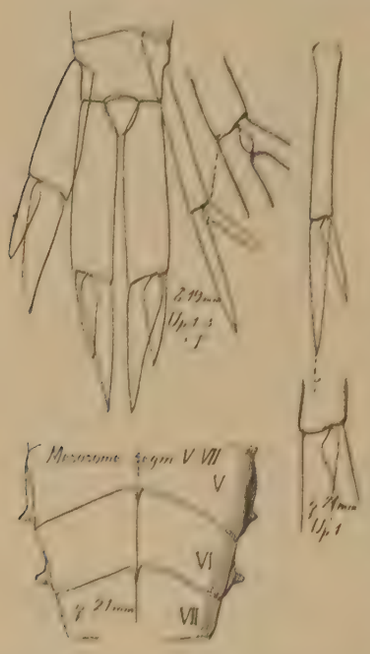

Fig. 47. *Themisto bispinosa*, st. 75, 1909, 300 mm. All figures drawn to the same scale except the detail figure of up. 1.

Mediterranean.

There are in all 8 spec. from 1 station, in the Bay of Piræus (St. 18). This is curiously enough the same — and only — place in the Mediterranean where the "Thor" found *T. compressa* forma *compressa*. The specimens are slightly divergent, the carpus of p. 3—p. 4 being a little too narrow (fig. 48) but p. 5 is rather typical, so that the determination for all that is hardly doubtful. It has not previously been found in the Mediterranean, and the locality must probably be due to a confusion of labels (see under *T. compressa*, forma *compressa*, p. 105).

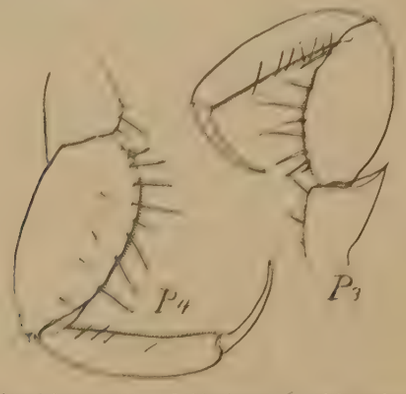

Fig. 48. *Themisto compressa* f. *bispinosa*, ♀ with embryos, 6 mm, st. 18, 1908, 300 mw. (P. 5 is in this spec. as in *T. bispinosa* but it has no dorsal teeth.)

Atlantic.

It has been taken within quite the same area as *T. compressa* forma *compressa*; at a good many stations they have even been taken together. The only important exception is that *T. bispinosa* has not been taken at the two extreme stations in the Bay of Biscay (St. 179, 1906, and St. 269, 1911).

Depth of the sea. It has been found at all depths, particularly 100—500 m (5 stations, *viz.* 100, 130, >150, 180 and 182—460 m) and 1000—2000 m (4 st.). The depth is thus somewhat different from that of *T. compressa* forma *compressa*, the latter form (f. *compr.*) having chiefly been found at greater depths (> 1000 m).

Depth in m.	No. of stations
100 – 500	5
> 500—1000	1
> 1000 -2000	4
> 2000– 3000	1
> 3000	2
total...	13

Vertical occurrence.

	No. of hauls.		
m. w.	Night	Day	N. + D. (Day?)
25	3		
65—150	4	3	1
250—400	4	3	
500—600	3		1
>1000		2	1
total...	14	8	3

The greater part of the hauls were made during the night with 25—600 m. w., during the day chiefly with 65—400 m. w.; this agrees particularly well with *T. compressa* f. *compressa*.

From the table below it appears that during the night the greatest number of specimens per haul was taken close to the surface (25 m. w.), but during the day with 250—400 m. w.

m. w.	No. of spec.		Average no. of spec. per haul	
	Night	Day	Night	Day
25	106	—	35	—
65—150	68	4	17	1
250—400	62	38	15	13
500—600	42	—	14	—

Propagation and size.

Of ♂ juv. (with short antennæ) the "Thor" took in March 1909—Sept. 1910 45 in all, the size varying between 6 and 19 mm. In March the size varies between

8—16 (19) mm, the greater number of spec. being 9—13 mm. In June the size is 10—12 mm and in Sept. the specimens are still smaller, only 6 mm.

♂ ad. was only taken in March (1909) and the size lies between 16 and 21 mm, particularly 16—19 mm.

Of ♀ with ova 3 spec. were taken in March, *viz.* of 7, 18 and 20 mm and in June 9 spec. of 10—16 mm; in September 3 spec., 6 and 9 mm.

Of ♀ without ova by far the greater number are in March only 5—9 mm, a few 10—12 mm. With the exception of 1 spec. of 15 mm there are none of the sizes 13—17 mm but a few specimens are 18—21 mm. In June, the sizes vary between 7 and 16 mm; the greater part are 10—13 mm and in Sept., the size is (5) 7—8 mm. The figures are: March 1909: 192 spec.; June 1910: 32 spec.; Sept. 1910: 47 spec.; total 271 spec. Unfortunately, there are among the 286 ♀ in all, taken in March 1909—Sept. 1910, only 15 ♀ with ova, so that we cannot deduce anything for certain from this as regards the most common spawning season; comparatively the greater number of ♀ with ova were found in June (9 ♀ with ova, as against 32 without ova).

Literature and Synonomy.

My reasons for considering *T. bispinosa* as merely a special form of *T. compressa* will be given below when dealing with the intermediary forms.

Vosseler, 1901, p. 81, 86 in classing *Euth. Gaudichaudi* (♂ juv., Stebbing 1888 Pl. 172) with *T. bispinosa*, is undoubtedly correct, though in spite of its considerable size ("$^{3}/_{5}$ of an inch") it lacks dorsal teeth and has a short carpal process in p. 2; on the other hand I cannot see that he is right in classing the specimen shown in Pl. 173 with *T. compressa* f. *compressa*, for the latter may also (from the armature on the metacarpus in p. 5) be a young specimen of *T. bispinosa*. On the other hand, it is true that it also presents certain points of resemblance with *T. gracilipes*, particularly in p. 5.

Both *Themisto antarctica* Dana (Bovallius 1889, p. 294) and *Th. Gaudichaudi* Guérin (see Bovallius ibid. p. 299) are undoubtedly *T. bispinosa*, and this possibly also holds good of *Euth. Thomsoni* Stebbing, which, however, rather stands as an intermediary form between *T. compressa* and *T. bispinosa* (see p. 110).

Distribution.

[Mediterranean, see above.]

1. Atlantic. Has a very wide distribution in the North Atlantic, especially South of abt. 66° N (abt. 80°?); for special localities see above, and my paper 1923, p. 31, with chart.

2. Southern Seas. Of the "species" which are in all probability synonymous with the present species, *T. antarctica* has been taken at the following localities: The Antarctic region: the Southern temperate regions of the Atlantic, of the Indian Ocean and of the Pacific (Bovallius 1889, p. 294). — South Atlantic (*E. Guerini* Bate = *T. antarct., teste* Bovallius 1889). — 68° S, 94° W (Antarctic Sea) (Dana).

T. Gaudichaudii: The Antarctic regions; the Southern temperate regions (Bovallius 1889, p. 299). — Falkland Islands (Guérin). — Patagonia 42°43′ S, 82°11′ W, surf., temp. 12° C.; Cape Virgin to Falkland Islands 51°35′ S, 65°39′ W, surf., temp. 9° C.; NE coast of Kerguelen Island, surf., temp. 5.5° C., many, most of them not full grown, $^{3}/_{5}$ inch (Stebbing, "Challenger") — 62°8′ S, 170°45′ E, surf. (?, Stewart 1913, p. 257). — 54°01′ S, 170°49′ E, to 63°4′ S, 175°43′ E, abundant, mostly young; a female with ova 15 mm (Walker 1907).

On this southern area see further below p. 110.

3 C. INTERMEDIATE FORMS BETWEEN THEMISTO COMPRESSA Goës forma COMPRESSA, and T. COMPRESSA forma BISPINOSA Boeck (Fig. 49).

Euthemisto compressa (partim) H. J. Hansen 1887, p. 59. — *E. c.* (partim) Vosseler 1901, p. 81, 86. — *E. bispinosa* (partim) Vosseler 1901, p. 82. — *E. Thomsoni* Stebbing 1888, p. 1414, Pl. 174—75, and *E. T.* ("*E. scabra*") Stebbing, ibid.

Atlantic.

St. 1. 28-11-1908. 25 m.w. 2^{50} am. 30 min. 1 ♀ jun.(?) 6 mm. — **St. 74.** 9-3-1909. 300 m.w., 10^{00} pm., 60 min. 4 ♀ 19-22 mm. — **St. 74.** ibid. 65 m.w., 1^{30} am., 60 min. 1 ♀. — **St. 74.** ibid. 600 m.w., 0^{15} am., 60 min. 2 ♀ 19 mm. — **St. 75.** 9-3-1909. 4300 m.w., 1^{45} pm., 120 min. 3 spec.: 1 ♂ ad. 18 mm, 2 ♀ 18—21 mm. — **St. 73.** 8-3-1909. 65 m.w., 3^{30} pm., 30 min. 30 spec.: 5 ♂ ad. 7—9 mm, 11 ♂ jun. 6—9 mm, 14 ♀ 6—11 mm. — **St. 80.** 13-6-1910. 65 m.w., 10^{00} pm., 30 min. 1 ♀ 13 mm. — **St. 245.** 17-9-1910. 150 m.w., 8^{55} pm., 15 min. 3 ♀: 8, 15, 16 mm. — **St. 124.** 61°04′ N, 4°33′ W. 23-7-1905. 1000 m.w. 5 spec.: 1 ♂ ad. 18 mm, 4 ♀ 14, 15, 18, 21 mm.

As already set forth in the foregoing (p. 103) the distinguishing of the two "species" has at times caused difficulties, as the specific characters mentioned by Sars and Vosseler are by no means always clearly developed.

H. J. Hansen (l. c.) states that they may vary to a certain extent (see above p. 103).

Vosseler (l. c. p. 82) also says that the two "species" can to a certain extent approach each other, but "vollkommene Zwischenformen fand ich nie."

In my list of localities given above I have noted the specimens which do not agree with either of the two "species", but combine the characters of both, and this, it will appear, does not only apply to small specimens of 6—7 mm, but also to large ones of up to 21 mm. The characters which cause difficulties are the very features, emphasized by H. J. Hansen (p. 3—p. 4, p. 5—p. 6).

Fig. 49. *Themisto compressa* or *Th. bispinosa*, intermediate form, st. 124, 1905. 1000 m.w. ♀ with ova, 15 mm. P.3—p.4 drawn twice as great asp. 5—p.6

Fig. 49 represents a female with ova, 15 mm from St. 124, 1905, 1000 m. w.; which can be taken as a type though it is nearer to *T. bispinosa* than several of the others. According to the carpus in p. 3—p. 4 it should more particularly be determined as *T. bispinosa*, though the outline of the carpus is by no means particularly typical; but as intermediate characters between the two species must be classed the length of p. 5 in proportion to p. 6 which is nearly 5:3 (according to Vosseler, this proportion in *T. compr.* is 13:11, in *T. bisp.* 2:1), and the teeth along the front margin of the metacarpus in p. 5 are too small to agree with Sars' fig. of *T. bisp.* but too large for *T. compressa*.

In other specimens the carpus in p. 3—p. 4 actually forms an intermediary stage between the two "species", or p. 6 will, when it and p. 5 are straightened out, extend to the proximal $^1/_3$—$^1/_4$ of the metacarpus of p. 5 i. e. the proportion of these legs as regards length is nearly as 3:4.

Synonymy and Distribution. All the intermediary forms from the "Thor" were taken within the same area of the Atlantic where the two "species" have been found. H. J. Hansen's specimens are from Greenland; in which locality the specimens mentioned by Vosseler were really taken, does not appear from his account.

I cannot see but that also *E. Thomsoni* Stebb. belongs here. Vosseler considers it synomous with *T. compressa*, and to this I can subscribe, as regards the entire animal, drawn by Stebbing, but the longest p. 5 drawn by Stebbing (Stebb.: prp. 3) agrees better with *T. bispinosa*. As p. 3—p. 4 agree best with *T. compr.* and p. 5 best with *T. bisp.*, it must thus be considered an intermediary form between the two "species".

E. Thomsoni has been found in the following localities: Between Marion Island and the Crozet Islands 46°46′ S, 45°31′ E, surf., daytime, 6° C., 14 spec.; off Crozet Islands 46°45′ S, 50°42′ E, surf., 5.5° C., 1 spec.; 50°1′ S, 123°4′ E, surf., 7° C., 3 spec.; S. Australia 48°18′ S, 130°4′ E, surf., 10° C., 6 spec.; ? between Kerguelen Island and Heard Island, surf.; ? 49°28′ S, 70°30′ E, 25 fms. ("*E. scabra*"). —

On the strength of the above it can thus be proved that *T. compressa* (the name taken in the widest sense) is bipolar. The two forms considered separately have the following distribution: *T. compr.* f. *compressa* has been found in the Atlantic north of 40° N (+ ?Mediterranean) and at 35°—36° S; *T. compr.* f. *bispinosa* has been found in the same localities, and also within the antarctic area, and the same holds good of the intermediary forms. Only quite exceptionally have specimens been taken at negative temperatures, and also very few at temperatures > 12° C., but all 3 forms have very wide limits of temperatures. Further, the biology must — in any case, as far as the two principal forms are concerned — be very nearly the same, since they are generally taken together.

This shows that *T. compressa* is bipolar, having been found in the Atlantic, North of 40° N (from the northern Pacific it has not been noted) and in the southern seas south of 35° S, whereas it is altogether lacking in the intervening area (apart from a single find 31.5° N, 45.6° W). This, as far as I know, is the first case of bipolarity proved in a Hyperid.

Genus Phronimopsis Claus.

Phronimopsis Claus, Phronimiden 1879, p. 63 (3). — *P.* Stebbing, 1888, p. 1373.— **P.* Bovallius 1889, p. 318 (lit.). — *P.* Vosseler 1901, p. 51. — *P.* H. Vester, Beiträge zur Kenntnis d. Gattung Phronimopsis; Dissertation, Leipzig 1900

1. PHRONIMOPSIS SPINIFERA Claus.

Phronimopsis spinifer Claus l. c. 1879, p. 64 (6), Pl. 1 fig. 1—3. — *P. spinifera* Bovallius 1889, p. 326 (lit.), Pl. 14 figs. 30—35. — *P. s.* Vosseler 1901, p. 52, Pl. 5 figs. 1 — 4.—*P. s.* Vosseler, in Lo Bianco 1903—04,

p. 278. — *P. Sarsii* Bovallius, Syst. list 1887, p. 23. — *P. S.* Bovallius 1889, p. 320, Pl. 14 fig. 1—29. — *P. tenella* Stebbing 1888, p. 1374, Pl. 164. — *P. t.* Bovallius 1889, p. 325. — *P. tumida* Vester, l. c. 1900, p. 9 seq., Pl. 1—2.

It is Vosseler (l. c. 1901) who considers *P. Sarsii* and *P. tenella* synonymous with *P. spinifera*, and I cannot see but that he is right in this.

In 1900 Vester (l. c.) established a new species, *P. tumida*, without knowing the works of Vosseler, or vice versa. This species, of which only females are available (taken at Capri and Ischia 450—1200 m below surf.) must absolutely be considered as older specimens of *P. spinifera*. The specific name refers to the highly inflated pereion but this also applies to *P. spinifera* and is thus no specific character.

From Vester's diagnosis (l. c. p. 9) of *P. spinifera* (quoted from Bovallius) compared with *P. tumida* it looks as if the two species deviate very considerably; but if one examines the figures of Bovallius and Vester it appears that it is principally only a verbal dispute.

The only real difference seems to me to be that in *P. tumida* the ova (according to Vester) are said to develop *within* the pereion, in *P. Sarsii* on the other hand in the usual marsupium *under* the pereion. My own specimens with ova have them within the pereion.

All my ♀ specimens, by the way, correspond quite well with Bovallius l. c. 1889, fig. 30, but are almost entirely devoid of spines on the dorsal side of the tail.

Mediteranean.

St. 141. 20-7-1910. 25 m.w., 10^{35} pm., 15 min. 1 ♂ 3.5 mm. — **St. 143.** 23-7-1910. Surf. (P. 100), 0^{40} am., 10 min. 1 ♂ 3.5 mm. — **St. 156.** 30-7-1910. Surf. (P. 100), 2^{25} am., 10 min. 1 ♂ 4 mm. — **St. 163.** 3-8-1910. 25 m.w., 1^{35} am., 15 min. 1 ♂ 3.5 mm. — **St. 282.** 8-3-1911. 40 m.w. (S. 100), 9^{00} pm., 90 min. 1 ♂ 3.5 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 10^{45} pm., 180 min. 1 ♂ 3.5 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 2 ♂ 3.5—4 mm.

Atlantic.

St. 398. 36°48′ N, 14°22′ W. 26-10-1911. Surf. (S. 200), 12^{40} pm., 30 min. 87 spec.: 82 ♂ 3.5 mm, 5 ♀ (1 with ova) 3.5 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. 4 spec.: 3 ♂ 3.5 mm, 1 ♀ with ova 3.5 mm.

The material. In the "Thor" material there are in all 99 spec. *viz.* 93 ♂ and only 6 ♀ from 8 stations, 9 hauls. The number of specimens previously known hardly exceeds 125.

Mediterranean.

Material and occurrence. There are 8 ♂ (no ♀) from 6 stations, 7 hauls. The depth is 530—3200 m., the depth of St. 282 (Messina Strait), however, being only 200 m. All the localities are in the eastern basin, about 13½°—27° E; St. 163 lies in the Ægean Sea. The species was previously known from Messina (Claus, Chun) and at Capri (thus in the western basin) (Vester 1900, Lo Bianco, 1902, p. 447 and 1904 ["Maja"] p. 43; Chun: Pelag. Thierwelt 1888, p. 29). Vosseler mentions (l. c. 1903—04) 29 spec. from 11 stations at Capri and 1 station at Salina (Eolian Isles); depth 600—2600 m. — Adriatic (Steuer 1913).

Vertical occurrence. All the "Thor" specimens were taken in March, June, July and November during the night from the surface to 40 m. w.; only the 2 spec. from St. 385 were taken at greater depths (122 m. w.). The result from the "Thor" agrees very well with what Steuer shows in a table from the southern Adriatic (Steuer 1913, p. 567, fig. 14): during the night it decreases evenly from the surface to a depth of 250 m, and then ceases; where it lives during the day is not stated.

The results from the "Thor" and from Steuer l. c. do not agree with the records in literature (Vosseler 1903—04: 500—2500 m. w. and closing net 100, 200—300 m.w. [daytime]; he had 12, it is 27 per cent., positive hauls, the "Thor" only 4 out of 268, it is not 2 per cent. — Lo Bianco (1904): 500—1500 m. w. (fore-noon). — Chun: Closing net 900—1000 m, or open net > 600 m down [day-time]).

Atlantic.

The two finds represented in the "Thor" collections agree quite well in every respect with the results of the "Thor" from the Mediterranean. They are interesting as bringing the species closer to the European coasts of the Atlantic than any previous find, and St. 398 also in showing a much greater number of individuals than any find that I know of; the largest find which I have seen recorded in the literature is 21 spec. from one of the stations in the South Equatorial Current (Vosseler 1901). This find further shows that the males can occur in shoals, for of the 87 spec. 82 were males.

Distribution.

1. Mediterranean see above.

2. Atlantic. The species has been taken at some localities in the northern temperate and tropical regions of the Atlantic, abt. 41½° N—abt. 5° S. Most of the localities are from the German Plankton-Exped. (Vosseler; 27 hauls, 72 spec. [26 ♂, 46 ♀], 0—400 [500] m); they are

as follows: Florida Current 2 st.: 41.6° N, 56.3° W, and 40.4° N, 57° W; Sargasso Sea 33.2° N, 63.8° W; N. Equatorial Current and Canarian Current 12 st.: 26.3° N, 32.5° W, to 10.2° N, 22.3° W, and 12° N, 40.3° W; Guinea Current 3 st. 5.3° N, 19.9° W, to 2.9° N, 18.4° W; S. Equatorial Current 9 st.: 1.1° N, 16.4° W, to 5.1° S, 14.1° W, and 1.5° S, 39.2° W. — From the same area it is mentioned by Bovallius from 17°22′ N, 37°33′ W, and 32° N, 77°45′ W (N. of Cuba). — *Ph. Sarsii* was taken in "tropical parts of the Atlantic" (Bovallius). — On the specimens from the "Thor", see above.

3. Pacific. "Lat. 35° N, Japan to Honolulu", surf., 1 spec. (*Ph. tenella*, Stebbing l. c.).

4. Indian Ocean. 4°16′ S, 71°53′ E, depth 2082 fms., 25 fms. below surf., 2^{10}—3^{10} am., 27.8° C. (Walker 1909—10, p. 51).

Fam. Dairellidæ (Bovall.) Vosseler.

Dairellinæ Bovallius, Syst. list 1887, p. 21, and 1889, p. 331. — *Dairellidæ* Vosseler 1901, p. 50.

The family only comprises 1 genus of 2 species, and only the one, *Dairella latissima*, is known from the area of the "Thor".

1. Genus Dairella Bovallius.

Dairella Bovallius l. c. 1887, p. 24, and *1889, p. 332 (key to the species). — **D.* Stebbing 1888, p. 1343.

1. DAIRELLA LATISSIMA Bowall.

Dairella latissima Bovallius l. c. 1887, p. 24. — **D. l.* Bovallius 1889, p. 336, Pl. 15 fig. 1—20. — *D. l.* Vosseler 1901, p. 51. — **D. Bovallii* Stebbing 1888, p. 1343, Pl. 158.

Mediterranean.

St. 115. 29-6-1910. 2000 m.w., 60 min., 0^{30} am. 1 ♀ 6.5 mm.
St. 206. 28-8-1910. 1000 m.w., 45 min., 1^{40} am. 1 ♀ 6.5 mm.
St. 209. 29-8-1910. 1000 m.w., 45 min., 6^{00} am. 1 ♀ 6 mm.
St. 209. ibid. 2000 m.w., 7^{25} am. 1 ♀ 6.5 mm.

Atlantic.

St. 82. 51°00′ N, 11°43′ W. 15-6-1905. 800 m.w. 1 ♀ 6 mm.
St. 167. 57°46′ N, 9°55′ W. 1-9-1905. 1500 m.w. 2 spec.: 1 ♂ jun. 6.5 mm, 1 ♀ 7 mm.

As will be seen from the above, the "Thor" has taken 7 spec. (1 ♂ juv., 6 ♀) in the western regions of the Mediterranean, and in the Atlantic. West of the British Isles the depth of the sea is everywhere very great, 1020—2800 m, and though several of the specimens, in any case in the Mediterranean, were taken during the night, they were all taken with a great length of wire, (800) 1000—2000 m. w.

All the finds in the Atlantic north of 40° N originate from 1904 and 1905 (see distribution), in which years it is known that there was a particularly strong north-going current west of the British Isles.

It seems always to have been taken singly, at most 2 at a time, and then always a male and a female. From the literature only some 10 specimens are known.

Colour. The lateral parts of the pereion and p. 3—p. 7 have dark red spots (Tattersall 1906 p. 18).

Distribution. 1. Mediterranean. Between Capo Corso and Monaco, 10^{40}—11^{40} am., 2000 m. w. (Vosseler in Lo Bianco 1903 p. 279), 1 ♂; Gulf of Genova, surf., 1 ♂, and South of Formentera, 0—1000 m, 1 ♂ (Chevreux 1913, p. 16). It has thus only been taken in the western basin.

2. Atlantic. The most northerly occurrences are the 2 "Thor" specimens, and a find west of Ireland, 1905, 1150 fms. w. (Tattersall 1906); Chevreux (l. c. 1913) notes 1 ♂ taken 1904 (St. 1639) at the entrance to the Bay of Biscay 46°15′ N, 7°09′ W, 0—3000 m. Otherwise the species is recorded from between the Azores and Lisbon, surf. 1 ♂ (Chevreux l. c. 1913), off St. Vincent 16°49′ N, 25°14′ W, surf. (?), ♂ and ♀ (Stebbing l. c.), 2.6° S, 14.6° W, surf., 1 ♂ (Vosseler l. c.) and between Tristan da Cunha and Cape of Good Hope 37°33¾′ S, 6°09′ E, 1 ♀ (Stewart 1913). Bovallius' type-specimen originated from "temperate and tropical parts of the Atlantic", without further particulars; but in spite of Bovallius' remarks that he borrowed the specimen from the Copenhagen Zoological Museum, we have no specimen which he can have seen.

Fam. Phronimidæ Dana.

Phronimidæ K. Stephensen 1923, p. 34 (lit.).

All the 8 known species are to be found in the "Thor" material with the exception of two i. e. *Phronima affinis* Voss. and *P. Stebbingi* Voss. The first-mentioned species is only known through a single specimen (from the Atlantic). *P. Stebbingi* on the other hand is rather widely distributed, in particular in the Atlantic, where, however, it has never been found within the area of the "Thor"; but it is recorded by Chevreux (1913) from the Mediterranean, *viz.* Monaco (0—140 and 0—250 m) and Cabo de Gata (E of Almeria, Spain), 0—1300 m, 2 ♀.

Of this family the "Thor"-Exp. has in all about 9150 spec., of which more than half, i. e. 4863, represent a single species (*Phronimella elongata*) (in these figures,

as well as in the figures given below from the German Plankton-Exp. the non free-living young are not included)

The only large expeditions from which we have reports of this family are the "Challenger" and the German Plankton-Exp. The "Challenger" had from 40 stations some 50 larger and a number of quite small spec. as well as a few houses. The greater part could not be determined. After deducting synonyms, the remainder only represent 3 species + 1 variety. The German Plankton-Exp. had 8 species (+ 1 var.), 883 spec.

Number of males and females.

From the "Thor" there are 5 species + 1 variety of *Phronima*, in all > 4300 spec. *viz.* 1140 ♂, > 3100 ♀, abt. 80 jun. There are very often at least twice as many ♀ as ♂, and the German Plankton-Exped., which alone of all other expeditions has procured a large material of this family, gives very nearly the same result. —

The species are oceanic and several of them probably cosmopolitans; but in the literature they have been very much confused so that it is not always possible to see which species is meant.

1. Genus Phronima Latr.

Phronima Stebbing 1888, p. 1346 (lit. and syn.). — *P.* Bovallius 1889, p. 342 (lit. and syn.). — *P.* Chun, Das Männchen d. Phronima sedent. nebst Bemerkungen üb. die Phronima-Arten; Zool. Anzeiger, 12. Jahrg., 1889, p. 378. — *P.* Chun, Atlantis. Biolog. Studien üb. pelag. Organismen IV, Die sekundären Geschlechtschar. d. Männchen von Phronima; Bibl. Zool., Heft 19, 1895, p. 109, Pl. 7—8. — *P.* Vosseler, Ueber d. Männchen von Phr. u. ihre sekundären Geschlechtsmerkmale; Zool. Anz. vol. 23, No. 620, 1900, p. 392. — **P.* Vosseler 1901, p. 1. — *P.* Woltereck, 2. Mitt. üb. Hyper. d. Deutsch. Tiefsee-Exped.: Physosoma, nebst Bemerk. zur Biol. von Thaumatops u. Phronima; Zool. Anz. vol. 27, No. 18, 1904, p. 560. — *P.* Woltereck, 3. Mitt. ....: Ergänzenden Bemerk. zur Biol. von Phronima u. Mimonectes; ibid. vol. 27, No. 20, 1904, p. 626.

As the species vary a good deal according to size, and as there is also a very considerable sexual difference, it is not strange that there should be a rather complex literature and synonomy; this applies in particular to the two first established species, *P. sedentaria* and *P. atlantica*. The difficulties are increased, because the same haul may at times contain several species. Reference may be made to Bovallius 1889, containing very detailed lists of literature, which, however, are not correct all through (his *P. sedentaria*, for instance, too comprehensive), but more especially to Vosseler 1901, to whom is due the honour of having fully elucidated the complicated problem, particularly as regards the males.

The genus comprises 7 species + 1 variety, which are all, with the exception of 2 species, represented in the "Thor" material.

In the subsequent lists, an attempt has been made to separate the species by means of simple characters. The characteristics, however, do not apply to quite small individuals.

♂. (♂ is not known of *P. atlantica* var. *solitaria*, *P. curvipes* and (?)*P. pacifica*. The references are to Vosseler 1901).

1. Ant. 2 rudimentary 2
1. — well developed 3
2. Carpus in p. 5 (apart from the carpal process and the notch inside this) in the distal end cut right off..... *P. affinis* (Vosseler Pl. 1, fig. 12, 15).
2. Carpus in p. 5 has inside the notch at the carpal process two separate teeth .. *P. sedentaria* (Vosseler Pl. 1, fig. 7, 10).
3. The distal edge of carpus of p. 5 has inside the carpal process 3—4 separate teeth, but no large process; metacarpus not longer than the breadth of carpus .....*P. Colletti* (Vosseler Pl. 4. fig. 1).
3. The distal end of carpus of p. 5 has inside the carpal process a tooth and a longer process with small excavations in the hind edge 4
4. Metacarpus not much longer than the breadth of carpus; inner ramus of up. 1 much longer than outer ramus, not much shorter than peduncle *P. Stebbingi* (Vosseler Pl. 4, figs. 8, 10).
4. Metacarpus somewhat longer than the breadth of carpus; inner ramus of up. 1 not longer than outer ramus, abt. half as long as the peduncle *P. atlantica* (Vosseler Pl. 2, fig. 6).

♀. (♀ of *P. affinis* is not known).

1. 1. metasome segment longer than 7. mesosome segment. Length 7 (10?) mm.. *P. Stebbingi* (Vosseler Pl. 4. fig. 4).
1. 1. metasome segment as long as or shorter than 7. mesosome segment..... 2
2. 1. metasome segment about as long as 7. mesosome segment 3
2. 1. metasome segment distinctly shorter (often only $^3/_4$ as long) than 7. mesosome segment.. 5
3. Carpus of p. 5 much longer than broad; metacarpus much longer than the distal edge of carpus; hind corners of metasome segments (especially no. 3) drawn out into a long point.

Length 36 (40) mm.. *P. sedentaria* (Vosseler Pl. 1 figs. 1—2).

3. Carpus of p. 5 not much longer than broad; metacarpus extends only a little beyond the carpal process; the hind corners of metasome are not drawn out into a long (but sometimes into a short) point 4

4. P. 5 much shorter than p. 4; the distal edge of carpus of p. 5 has besides the carpal process 3—4 other teeth. Length 9 (18?) mm.. *P. Colletti* (Vosseler Pl. 3 figs. 8, 10).

4. P. 5 not much shorter than p. 4; the distal edge of carpus of p. 5 has besides the carpal process another tooth and a curved process with small excavations in the hind edge. Length 11 mm *P. pacifica* (Vosseler Pl. 3 fig. 4.)

5. The process inside the carpal process of p. 5 is bifid. Length 17—25 mm.. *P. atlantica* (Vosseler Pl. 2 fig. 1).

5. The process inside the carpal process is single, not bifid 6

6. Hind edge of femur of p. 5 almost straight. Length 22 mm.. *P. atlantica* var. *solitaria* (Vosseler Pl. 2 fig. 5).

6. Hind edge of femur of p. 5 strongly curved almost as S. Length 11—17 mm.. *P. curvipes* (Vosseler Pl. 3 fig. 1, and the present paper fig. 52).

Propagation and vertical migrations.

The peculiar symbiosis, or rather parasitism, in different oceanic animals of tube-like shape, early aroused an interest in this genus, which interest is of course further stimulated by the comparatively considerable size of at any rate the one species (*P. sedentaria*). It is therefore one of the very few genera within the Hyperiidea, where mention has been made of biology, but the value of the information given on this point is often very much discounted by the fact that we cannot as a rule see which is the species in question.

In cases where the name of the species is not mentioned, one may say, with a fair degree of certainty, that the data given refer to *P. sedentaria* and *P. atlantica*, as these are the most abundant species in the waters from which information is available (Mediterranean and Northern Atlantic). Of the remaining species, *P. Colletti* and *P. Stebbingi* may perhaps be taken into consideration, these also being fairly numerous, in any case in parts of these waters. As to what is mentioned below, we may, I think, take it for granted, that it applies to *P. sedentaria* and *P. atlantica*.

One common feature appears over and over again in the literature *viz.* that propagation takes place at the surface, and that the young when they have left the house of the mother, seek the deep, in order to migrate to the upper layers, when they are full-grown and are going to propagate (Chun, Bibliotheca Zoologica 19, 1895, p. 110—11; Woltereck, Zool. Anzeiger, 27, 1904, p. 561 & 626; ?Tattersall 1906 as to *P. sedentaria*). The only fact to substantiate this theory is that Woltereck (p. 561) has seen in aquaria that the young ones actively seek the darkness, while larger animals actively seek the light, and that at the surface (at Villafranca during the spring only, at the Canaries as early as Jan. [Chun]) only the adults are to be found. As will appear from the following, this was not corroborated by the "Thor", the collections of which in several cases even seem to prove the contrary.

Woltereck records that at Villafranca, adult *Phronima* (♂, ♀) are to be found at the surface during the spring only, whereas deep down they are to be found all the year round. Also, ♂ are said to haunt the surface for a much shorter period than ♀. Nevertheless the "Thor" did not take any ♂ of *P. sedentaria* and *P. atlantica* at the surface during the winter, but during the summer not so very few. W.s record on the vertical distribution of ♀ (and young) agrees with *P. atlantica*, not with *P. sedentaria*.

Chun 1895 makes a similar statement to that of Woltereck, and adds that off the Canaries, the ascent to the surface is already taking place in January.

Steuer (1913, table p. 567) shows that in the southern Adriatic the *Phronima* (specific name not given) at the end of August are most abundant during the night at about 250 m below the surface.

1. PHRONIMA SEDENTARIA Forskål

(Figs. 50—51, Chart 15).

Phronima sedentaria Bovallius 1889, p. 354 (partim, lit.), Pl. 16 figs. 1—3. — **P. s.* Vosseler 1901, p. 14 (lit.), Pl. 1 figs. 1—11. — *P. s.* Tattersall 1906, p. 18. — *P. s.* R. Minkiewicz, Mémoire sur la biologie du Tonnelier de Mer (*Phronima sedentaria*); Bull. Inst. Océanogr. Monaco, Nos. 146 and 152, 1910. — *P. s.* K. Stephensen 1923, p. 34 (lit.). — non *P. s.* Claus, Zeitschr. Wiss. Zool., vol. 22. 1872, p. 331, Pl. 26—28 (♂ = *P. Colletti*, ♀ = *P. atlantica*). — non *P. s.* Chun, Zool. Anzeiger vol. 12, 1889, p. 378 (= *P. atlantica*). — *P. custos* Risso 1816, p. 121, Pl. 2 fig. 2.

P. custos is no doubt correctly ascribed by Bovallius to the present species on the strength of the shape of

the carpus in p. 5, and the extension of the hindmost lateral corners of the metasome segments (Risso Pl. 2 fig. 3); by Vosseler, on the other hand, with ? ascribed to *P. atlantica* var. *solitaria*. —

The Copenhagen Zoological Museum possesses one of Forskål's type-specimens, which measures 26 mm and has kept its house; it originates from the old Museum Academicum.

Mediterranean.

St. 10. 15-12-1908. 65 m.w., 6^{10} am., 60 min. 2 ♀ 8 mm. — **St. 10.** ibid. 300 m.w., 8^{10} am., 30 min. 1 ♀ 31 mm. — **St. 10.** ibid. 600 m.w., 3^{45} pm., 60 min. 1 ♀ 19 mm. — **St. 11.** 16-12-1908. 65 m.w., 5^{25} am., 60 min. 1 ♀ 12 mm. — **St. 11.** ibid. 300 m.w., 7^{00} am., 120 min. 2 ♀ 13—19 mm. — **St. 12.** 19-12-1908. 65 m.w., 1^{00} pm., 30 min. 1 ♀ 16 mm. — **St. 12.** ibid. 300 m.w., 11^{40} am., 60 min. 1 ♀ 16 mm. — **St. 24.** 16-1-1909. 300 m.w. (hour?). 1 ♀ 30 mm in the house with young 1.5—3 mm. — **St. 25.** 17-1-1909. 65 m.w., 4^{40} pm., 30 min. 1 ♂ (ad.?) 7 mm; 1 ♀ 10 mm. — **St. 26.** 19-1-1909. 25 m.w., 4^{20} am, 120 min. 2 ♀ 17—19 mm. — **St. 26.** ibid. 150 m.w., 0^{50} am., 180 min. 5 spec.: 1 ♂ ad. 8 mm, 4 ♀ 12, 13, 14, 21 mm. — **St. 26.** ibid. 300 m.w., 6^{40} am., 180 min. 8 ♀: 8, 10, 10, 10, 13, 17, 18, 24 mm. — **St. 28.** 19-1-1909. 400 m.w., 6^{40} pm., 30 min. 2 ♀ 33—36 mm, in their houses, with embryos 2 mm. — **St. 28.** ibid. 65 m.w., 11^{00} pm., 120 min. 2 ♀ 12 mm. — **St. 29.** 20-1-1909. 600 m.w., 9^{30} pm., 60 min. 1 ♀ 12 mm. — **St. 31.** 22-1-1909. 200 m.w., 3^{15} am., 30 min. 14 spec: 3 ♂ jun. 5—7 mm, 9 ♀ 5—7 mm, 2 ♀ 9—13 mm. — **St. 33.** 22-1-1909. 65 m.w., 6^{30} pm., 30 min. 5 ♀: 5, 7, 7, 10, 18 mm. — **St. 34.** 23-1-1909. 25 m.w., 4^{35} am., 30 min. 1 ♀ abt. 12 mm. — **St. 34.** ibid. 200 m.w., 6^{35} am., 30 min. 3 spec.: 1 ♂ jun. 8 mm, 2 ♀ 9-11 mm. — **St. 35.** 29-1-1909. 25 m.w., 9^{10} pm., 60 min. 24 ♀: 1 ♀ 8 mm, 22 ♀ 9—19 mm, 1 ♀ 24 mm. — **St. 35.** ibid. 200 m.w., 6^{40} pm., 60 min. 2 ♀ 19—21 mm. — **St. 35.** ibid. 300 m.w., 9^{40} pm., 120 min. 3 spec.: 1 ♂ jun. 7 mm, 1 ♂ ad. 7 mm, 1 ♀ 15 mm. — **St. 35.** ibid. 700 m.w., 11^{25} am., 120 min. 1 ♀ 22 mm. — **St. 36.** 30-1-1909. 65 m.w., 5^{35} am., 60 min. 12 ♀ 11—24 mm. — **St. 36.** ibid. 300 m.w., 6^{50} am., 60 min. 7 ♀: 5 ♀ 9—14 mm, 2 ♀ 18—19 mm. — **St. 38.** 31-1-1909. 25 m.w., 7^{10} pm., 30 min. 4 ♀ 9—12 mm. — **St. 38.** ibid. 150 m.w., 8^{20} pm., 30 min. 1 ♀ 12 mm. — **St. 40.** 1-2-1909. 65 m.w., 9^{30} pm., 30 min. 12 spec.: 3 ♂ jun. 7 mm, 5 ♀ 9—10 mm, 4 ♀ 11—13 mm. — **St. 46.** 7-2-1909. 300 m.w., 7^{30} pm., 30 min. 6 ♀: 2 ♀ 9—11 mm, 4 ♀ 26, 27, 28, 30 mm. — **St. 47.** 10-2-1909. 300 m.w., 11^{05} pm., 30 min. 7 spec.: 1 ♂ jun. 7 mm, 1 ♀ 8 mm, 4 ♀ 13—14 mm, 1 ♀ 17 mm. — **St. 50.** 17-2-1909. 25 m.w., 1^{20} am., 30 min. 2 ♀ 13—17 mm. — **St. 50.** ibid. 600 m.w., 3^{25} am., 30 min. 1 ♀ 28 mm. — **St. 51.** 18-2-1909. 300 m.w., 0^{50} am., 30 min. 7 ♀: 8, 9, 10, 11, 13, 13, 22 mm. — **St. 53.** 18-2-1909. 2600 m.w., 5^{15} pm. 4 ♀ 13—16 mm. — **St. 55.** 19-2-1909. 65 m.w., 7^{40} am., 60 min. 1 ♀ 18 mm. — **St. 57.** 20-2-1909. 200 m.w., 6^{35} am., 30 min. 3 ♀ 8, 10, 13 mm. — **St. 58.** 20-2-1909. 65 m.w., 3^{00} p.m, 30 min. 1 ♀ 13 mm. — **St. 58.** ibid. 100 m.w., 2^{00} pm., 30 min. 3 spec.: 1 ♂ jun. 7 mm, 2 ♀ 5—10 mm. — **St. 59.** 21-2-1909. 500 m.w., 1^{40} am., 30 min. 3 ♀ 13, 17, 18 mm. — **St. 59.** ibid. 1200 m.w., 2^{30} am., 60 min. 30 spec.: 1 ♂ jun. 7 mm, 2 ♀ 8—9 mm. — **St. 106.** 25-6-1910. 300 m.w., 1^{45} am., 30 min. 1 ♀ 10 mm. — **St. 106.** ibid. 1200 m.w., 0^{20} am., 60 min. 4 spec.: 1 ♂ jun. 7 mm, 3 ♀ 11, 15, 21 mm. — **St. 112.** 27-6-1910. 25 m.w., 1^{30} am., 15 min. 1 ♀ 6 mm. — **St. 115.** 29-6-1910. 65 m.w., 1^{20} am., 15 min. 1 ♀ 7 mm. — **St. 115.** ibid. 300 m.w., 11^{20} pm., 30 min. 5 spec.: 1 ♂ jun. 8 mm, 3 ♀ 8, 12, 19 mm, 1 ♀ with ova 26 mm. — **St. 115.** ibid. 2000 m.w., 0^{30} am., 60 min. 1 ♀ 8 mm, 1 ♀ with its house 27 mm. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 15 spec.: 1 ♂ ad. 8(?) mm, 5 ♂ jun. 5—7 mm, 9 ♀ 5—6 mm. — **St. 116.** ibid. 65 m.w., 2^{30} am., 30 min. 14 spec.: 5 ♂ jun. 5—6 mm, 8 ♀ 6—9 mm. 1 ♀ 19 mm. — **St. 116.** ibid. 300 m.w., 1^{40} am., 30 min. 9 spec.: 2 ♂ jun. 6 mm, 7 ♀ 18, 18, 21, 25, 26, 28, 30 mm. — **St. 118.** 1-7-1910. 25 m.w., 0^{20} am., 15 min. 7 spec.: 2 ♂ jun. 6—7 mm, 5 ♀ 9, 10, 12, 13, 13 mm. — **St. 118.** ibid. 65 m.w., 11^{35} pm., 30 min. 7 spec.: 2 ♂ jun. 7 mm, 5 ♀ 8, 8, 9, 9, 14 mm. — **St. 118.** ibid. 300 m.w., 10^{55} pm., 30 min. 14 spec.: 1 ♂ jun. 7 mm, 1 ♂ ad. 8 mm, 10 ♀ 5—14 mm, 2 ♀ 22—29 mm (the greater one with ova) with their houses. — **St. 120.** 1-7-1910. 300 m.w., 8^{50} pm., 30 min. 11 spec.: 1 ♂ ad. 9 mm, 2 ♀ 8—10 mm, 8 ♀ 18, 19, 22, 25, 25, 28, 29, 30 mm (with ova in marsupium), 3 houses, in one of them two groups (each abt. 100 spec.) of small embryos, 1 mm in length. — **St. 121.** 2-7-1910. 25 m.w., 3^{35} am., 30 min. 5 spec. abt. 7 mm: 2 ♂ (ad.?), 2 ♂ jun., 1 ♀. — **St. 122.** 2-7-1910. 600 m.w., 10^{00} pm., 60 min. 2 ♀ 21—26 mm, one of them with its house. — **St. 122.** ibid. 1200 m.w., 5^{30} pm., 60 min. 2 ♂ jun. 7 mm, 3 ♀ 13, 20, 25 mm. — **St. 123.** 3-7-1910. 10 m.w. 2^{30} am., 15 min. 1 ♀ 11 mm. — **St. 123.** ibid. 25 m.w., 1^{50} am., 15 min. 14 spec.: 1 ♂ ad. 7 mm, 5 ♂ jun. 5—7 mm, 6 ♀ 8—9 mm, 2 ♀ 9—10 mm. — **St. 123.** ibid. 65 m.w., 0^{55} am., 30 min. 7 spec.: 2 ♂ jun. 7 mm, 5 ♀ 6—9 mm. — **St. 123.** ibid. 300 m.w. 0^{05} am., 30 min. 7 spec.: 2 ♂ ad. 8—9 mm, 2 ♂ jun. 6—7 mm, 3 ♀ 9, 11, 28 mm. — **St. 125.** 9-7-1910. 25 m.w., 10^{30} pm., 30 min. 1 ♀ 14 mm. — **St. 125.** ibid. 300 m.w., 9^{45} pm., 30 min. 4 ♀: 10, 11, 18, 20 mm. — **St. 126.** 10-7-1910. 300 m.w., 9^{30} pm., 30 min. 11 spec.: 4 ♂ ad. 8 mm, 2 ♂ jun. 6 mm, 4 ♀ 14, 16, 17, 18 mm, 1 ♀ in its house 29 mm, with embryos (3—4 mm). — **St. 129.** 12-7-1910. 25 m.w., 3^{00} am., 30 min. 1 ♀ 6 mm. — **St. 129.** ibid. 300 m.w., 3^{40} am., 30 min. 4 spec.: 2 ♂ jun. 6 mm, 2 ♀ 8—11 mm. — **St. 129.** ibid. 3500 m.w., 3^{00} pm., 120 min. 1 ♀ 7 mm. — **St. 131.** 13-7-1910. 300 m.w., 10^{35} am., 30 min. 1 ♀ 16 mm. — **St. 132.** 14-7-1910. 25 m.w., 3^{05} am., 30 min. 1 ♂ jun. 6 mm. — **St. 132.** ibid. 300 m.w., 3^{45} am., 30 min. 46 spec.: 2 ♂ ad. 7 mm, 11 ♂ jun. 7 mm, 32 ♀ 7—13 mm, 1 ♀ 16 mm. — **St. 132.** ibid. 600 m.w., 4^{50} am., 30 min. 13 spec.: 3 ♂ jun. 5—7 mm, 7 ♀ 5—8 mm, 3 ♀ 10—12 mm. — **St. 133.** 14-7-1910. 300 m.w., 10^{15} pm., 30 min. 4 ♀: 7, 7, 10, 12 mm. — **St. 133.** ibid. 600 m.w., 9^{20} pm., 30 min. 2 spec.: 1 ♂ jun. 8 mm, 1 ♀ 7 mm. — **St. 134.** 15-7-1910. 300 m.w., 5^{40} am., 30 min. 4 spec.: 1 ♂ jun. 7 mm, 3 ♀ 8, 9, 11 mm. — **St. 137.** 19-7-1910. 250 m.w., 9^{05} am., 30 min. 1 ♀ 9 mm. — **St. 138.** 19-7-1910. 300 m.w., 9^{10} pm., 30 min. 5 ♀ 5—14 mm. — **St. 139.** 20-7-1910. 25 m.w., 1^{40} am., 30 min. 2 ♀ 4—6 mm. — **St. 143.** 23-7-1910. 300 m.w., 0^{30} am., 30 min. 1 ♀ 20 mm. — **St. 144.** 24-7-1910. 2000 m.w., 3^{45} am., 60 min. 1 ♀ 23 mm. — **St. 145.** 25-7-1910. 300 m.w., 4^{10} am., 30 min. 9 spec.: 3 ♂ jun. 5 mm, 6 ♀ 5, 7, 7, 9, 12, 13 mm. — **St. 147.** 25-7-1910. 25 m.w., 11^{35} pm., 30 min. 4 ♀: 7, 8, 13, 17 mm. — **St. 147.** ibid. 300 m.w., 0^{20} am., 30 min. 1 ♂ ad. 7 mm, 1 ♂ jun. 6 mm. — **St. 147.** ibid. 1000 m.w., 1^{10} am., 60 min. 2 ♂ ad. 8 mm, 1 ♂ jun. 7 mm. — **St. 154.** 29-7-1910. 300 m.w., 4^{30} am., 30 min. 1 ♀ 7 mm. — **St. 156.** 30-7-1910. 300 m.w., 3^{50} am., 30 min. 3 spec.: 1 ♂ jun. 7 mm, 2 ♀ 8—12 mm. — **St. 160.**

1-8-1910. 1000 m.w., 3^{35} am., 60 min. 7 spec.: 4 ♂ ad. 7—8 mm, 1 ♂ jun. 7 mm, 2 ♀ 8—11 mm. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 5 spec.: 1 ♂ jun. 5 mm, 4 ♀ 8, 16, 17, 17 mm. **St. 163.** 3-8-1910. 300 m.w., 1^{05} am., 15 min. 2 ♀ 6—7 mm. **St. 182.** 13-8-1910. 600 m.w., 11^{40} pm., 30 min. 1 ♂ ad. 8 mm. — **St. 186.** 17-8-1910. 10 m.w.; 11^{30} pm., 15 min. 5 ♀ 9, 10, 12, 13, 14 mm. — **St. 186.** ibid. 300 m.w., 8^{15} pm., 15 min. 3 spec.: 1 ♂ jun. 7 mm, 2 ♀ 9—23 mm. — **St. 187.** 18-8-1910. 25 m.w., 7^{45} pm., 15 min. 12 spec.: 2 ♂ jun. 5—7 mm, 5 ♀ 6 mm, 5 ♀: 11, 12, 12, 14, 17 mm. — **St. 187.** ibid. 300 m.w., 0^{55} pm., 30 min. 1 ♀ 11 mm. — **St. 187.** ibid. 1000 m.w., 6^{40} pm., 30 min. 3 ♀ 12, 14, 16 mm. — **St. 192.** 20-8-1910. 25 m.w., 9^{40} pm., 15 min. 3 spec.: 1 ♂ jun. 4 mm, 2 ♀ 7 mm. — **St. 192.** inid. 300 m.w., 10^{10} pm., 15 min. 3 spec.: 1 ♂ ad. 8 mm, 1 ♂ jun. 4 mm, 1 ♀ 8 mm. — **St. 193.** 21-8-1910. 10 m.w., 0^{50} am., 15 min. 4 spec.: 1 ♂ jun. 4 mm, 3 ♀ 4—6 mm. — **St. 194.** 21-8-1910. 25 m.w., 5^{00} am., 15 min. 4 ♂ jun. 5—6 mm. — **St. 194.** ibid. 1200 m.w., 6^{00} am., 30 min. 3 spec.: 2 ♂ ad. 7 mm, 1 ♀ 5 mm. — **St. 195.** 21-8-1910. 65 m.w. 6^{50} pm., 15 min. 3 ♂ jun. 5, 6, 7 mm. — **St. 196.** 22-8-1910. 25 m.w., 2^{40} am., 30 min. 3 spec.: 2 ♂ jun. 5—6 mm, 1 ♀ 6 mm. — **St. 197.** 24-8-1910. 25 m.w., 7^{45} pm., 15 min. 12 spec.: 3 ♂ jun. 5-8 mm, 7 ♀ 6—8 mm, 2 ♀ 9—11 mm. — **St. 199.** 25-8-1910. 25 m.w., 9^{00} pm., 15 min. 8 spec.: 5 ♂ jun. 5—7 mm, 3 ♀ 6—8 mm. — **St. 199.** ibid. 300 m.w., 9^{25} pm., 20 min. 20 spec.: 1 ♂ ad. 7 mm, 5 ♂ jun. 6—7 mm, 14 ♀: 11, 11, 12, 12, 15, 18, 19, 20, 20, 21, 24, 24, 27, 28 mm. — **St. 199.** ibid. 1000 m.w., 10^{10} pm., 30 min. 4 spec.: 1 ♂ jun. 7 mm, 3 ♀ 6, 8, 9 mm. — **St. 200.** 26-8-1910. 25 m.w., 3^{45} am., 30 min. 1 ♀ 13 mm. — **St. 202.** 26-8-1910. 300 m.w., 5^{05} pm., 15 min. 9 spec.: 1 ♂ ad. 7 mm, 4 ♂ jun. 6—7 mm, 4 ♀ 8—10 mm. — **St. 204.** 27-8-1910. 65 m.w., 4^{30} am., 15 min. 3 ♀: 6, 9, 15 mm. **St. 204.** ibid. 300 m.w., 5^{00} am., 30 min. 2 spec.: 1 ♂ jun. 7 mm, 1 ♀ 12 mm. — **St. 204.** ibid. 1000 m.w., 5^{55} am., 30 min. 2 ♀ 8—14 mm. — **St. 205.** 27-8-1910. 25 m.w., 7^{35} pm., 15 min. 2 ♀ 6 mm. — **St. 206.** 28-8-1910. 300 m.w., 1^{05} am., 15 min. 7 spec.: 2 ♂ ad. 8 mm, 1 ♂ jun. 7 mm, 4 ♀ 6, 11, 18, 18 mm. — **St. 206.** ibid. 1000 m.w., 1^{40} am., 45 min. 3 spec.: 1 ♂ ad. 8 mm, 2 ♀ 8—19 mm. — **St. 207.** 29-8-1910. 1000 m.w., 6^{00} am., 45 min. 3 spec.: 2 ♂ ad. 8 mm, 1 ♀ 15 mm, with its house. — **St. 208.** 29-8-1910. 25 m.w., 1^{40} am., 15 min. 3 ♀ 4, 6, 6mm. — **St. 209.** 29-8-1910. Vertical net 75—35 m, 4^{10} pm. 1 ♀ 4 mm. — **St. 209.** ibid. 100 m.w., 3^{45} am., 20 min. 1 ♀ 29 mm, in its house, with abt. 200 young, 4 mm. — **St. 209.** ibid. 150 m.w., 4^{25} am., 20 min. 1 ♀ 5 mm. — **St. 209.** ibid. 300 m.w., 5^{25} am., 15 min. 9 spec.: 3 ♂ jun. 6—7 mm, 2 ♀ 6 mm, 4 ♀ 9—10 mm. — **St. 209.** ibid. 1000 m.w., 6^{00} am., 41 min. 1 ♀ 31 mm, with small embryos (0.75 mm) in the marsupium. — **St. 209.** ibid. 2000 m.w., 7^{25} am., 45 min. 1 ♀ 14 mm. — **St. 210.** 30-8-1910. Surf. (P. 100), 2^{50} am., 10 min. 1 ♀ 7 mm. — **St. 210.** ibid. 25 m.w., 2^{45} am., 30 min. 1 ♀ 18 mm. — **St. 210.** ibid. 600 m.w., 3^{35} am., 30 min. 3 spec.: 1 ♂ ad. 8 mm, 2 ♀ 23—26 mm. — **St. 218.** 2-9-1910-. 300 m.w., 2^{45} am., 30 min. 1 ♀ 18 mm. — **St. 222.** 4-9-1910. 300 m.w., 11^{20} pm., 30 min. 1 ♂ jun. 7 mm. — **St. 223.** 5-9-1910. 25 m.w., 4^{35} am., 15 min. 1 ♀ 12 mm. — **St. 275.** 39°5′ N, 14°50′ E. 3-4-1911. 94 m.w. (S. 200), 8^{30} pm., 30 min. 6 spec.: 4 ♂ jun. 5—6 mm, 2 ♀ 6—7 mm. — **St. 276.** 36°30′ N, 19°20′ E. 4-4-1911. 132 m.w. (S. 200), 11^{20} pm., 35 min. 2 ♀ 11—16 mm. — **St. 277.** 33°20′ N, 27°30′ E. 6-4-1911. 132 m.w. (S. 200), 11^{00} pm., 35 min. 32 ♀: 2 ♀ 5—9 mm, 8 ♀ 13 mm, 1 ♀ 18 mm, 21 ♀ 20—30 mm. — **St. 282.** 9-3-1911. 40 m.w. (S. 100), 3^{30} am., 90 min. 1 ♀ 5 mm. — **St. 297.** 33°10′ N, 25°35′ E. 25-6-1911. 28 m.w. (S. 200), 11^{30} pm., 30 min. 9 spec.: 2 ♂ jun. 5—6 mm, 5 ♀ 5 mm, 2 ♀ 8—9 mm. — **St. 298.** 34°20′ N, 21°10′ E. 26-6-1911. 38 m.w. (S. 200), 11^{30} pm., 30 min. 13 spec.: 3 ♂ jun. 6 mm, 10 ♀ 8—11 mm. — **St. 339.** 40°30′ N, 3°10′ E. 20-8-1911. 28 m.w. (S. 200), 3^{00} am., 30 min. 2 ♀ 7—8 mm. — **St. 340.** 35°50′ N, 21°30′ E. 26-8-1911. 108 m.w. (S. 150), 9^{00} pm., 2 ♂ jun. 4—7 mm. — **St. 341.** 34°00′ N, 26°20′ E. 27-8-1911. 28 m.w., (S. 200), 11^{00} pm., 30 min. 1 ♀ 7 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 3 spec.: 2 ♂ jun. 7 mm, 1 ♀ 6 mm. — **St. 410.** 37°12′ N, 1°18′ W. 29-12-1911. 112 m.w. (S. 150), 7^{00} pm., 4 ♂ jun. 4—6 mm. — **St. 412.** 34°33′ N, 24°15′ E. 7-1-1912. 112 m.w. (S. 150). 2 spec.: 1 ♂ jun. 4 mm, 1 ♀ 7 mm. **St. 730.** 38°26′ N, 13°27′ E. 16-4-1913. 2^{00} pm. 1 ♀ 30 mm, in the house, with ova.

Atlantic.

St. 72. 57°52′ N, 9°53′ W. 8-6-1905. 1500 m.w. 2 spec.: 1 ♂ jun. 7 mm, 1 ♀ 26 mm. — **St. 70.** 57°45′ N, 9°57′ W. 7-6-1905. 65 m.w. 2 ♀ 17—19 mm. — **St. 81.** 51°32′ N, 12°3′ W. 13(14)-6-1905. 300 m.w. 11^{45} pm. 14 ♀, all with houses: 17 (2 spec.), 26, 27, 28, 29 (3 spec., 1 with ova), 30 (with embr. 4 mm), 31 (4 spec., 2 with ova), 35 mm; besides several small, 4—5 mm. — **St. 82.** 51°00′ N, 11°45′ W. 14-6-1905. 300 m.w. 1^{35} am., 1 ♂ jun. 6 mm. — **St. 82.** ibid. 300 and 600 m.w. Abt. 75 spec. 5 mm. — **St. 82.** ibid. 800 m.w. 3^{45} pm., 18 spec.: 2 ♂ (ad.?) 7—8 mm, 4 ♀ 10—11 mm, 6 ♀ 14—19 mm, 6 ♀ 23—30 mm. — **St. 82.** ibid. 800 and 1200 m.w. 24 spec.: 3 ♂ ad. 7—8 mm, 3 ♂ jun. 5—7 mm, 2 ♀ 8 mm, 1 ♀ 11 mm, 1 ♀ 16 mm, 9 ♀ 26—28 mm, 5 ♀ 20—24 mm; 2 houses. — **St. 82.** ibid. 1200 m.w., 0^{45} pm., 120 min. 5 ♀: 1 ♀ 21 mm, 3 ♀ 24 mm, 1 ♀ 29(?) mm. — **St. 88.** 48°09′ N, 8°30′ W. 20-6-1905. 300 m.w., 8^{45} pm. 13 ♀: 7 ♀ 18—21 mm. 3 ♀ 22—24 mm, 2 ♀ 26 mm, 1 ♀ with ova 28 mm. — **St. 90.** 47°47′ N, 8°00′ W. 21(22)-6-1905. 300 m.w. 2^{15} am., 9 ♀: 4 ♀ 16—20 mm, 2 ♀ 22—23 mm, 3 ♀ 28—30 mm. — **St. 164.** 61°20′ N, 11°00′ W. 29-8-1905. 65 m.w. 2 ♀: 1 ♀ 27 mm with a group of small embryos (1.25 mm) in the house, 1 ♀ 28 mm with its house. — **St. 165.** 60°00′ N, 10°35′ W. 29-8-1905. 1600 m.w. 1 ♀ 28 mm, with several hundred embryos (2 mm) in the house. — **St. 167.** 57°46′ N, 9°55′ W. 31-8-1905. 300 m.w. 3 ♀: 4, 17, 23 mm. — **St. 167.** ibid. (m.w.?). 2 spec.: 1 ♂ jun. 5 mm, 1 ♀ 11 mm. — **St. 167.** ibid. 1500 m.w. 8 ♀: 2 ♀ 4 mm, 6 ♀ 11, 16, 16, 21, 22, 23 mm. — **St. 36.** 44°27′ N, 2°37′ W. 10-5-1906. 800 m.w., 9^{05} am. 1 ♀ 24 mm. — **St. 37.** 44°01′ N, 2°49′ W. 11-5-1906. 300 m.w. 7^{05} pm. 1 ♀ 30 mm. — **St. 52.** 48°42′ N, 12°20′ W. 21-5-1906. 300 m.w., 6^{10} am. 3 ♀: 29, 31, 33 mm (the last one with ova). — **St. 62.** 50°25′ N, 12°44′ W. 5-6-1906. 1500 m.w., 2^{45} am. 10 ♀: 12, 19, 22, 24, 24, 25, 26 mm (4 spec.; 1 with ova). — **St. 63.** 49°27′ N, 13°22′ W. 5-6-1906. 300 m.w. 5^{30} pm. 2 ♀ 17 mm. — **St. 72.** 48°40′ N, 11°30′ W. 8-6-1906. 300 m.w. 9^{00} pm. 1 ♀ 19 mm. — **St. 74.** 49°23′ N, 12°13′ W. 10-6-1906. 2000 m.w., 6^{35} am. 4 ♀: 20, 22, 26, 29 mm (the last one with ova). — **St. 74.** ibid. Eel seine 2000 m.w., 1^{20} pm. 1 ♀ 25 mm, with its house. — **St. 74.** ibid. Eel seine 2500 m.w., 9^{50} pm. 1 ♀ 31 mm. — **St. 76.** 49°27′ N, 13°33′ W. 11-6-1906. 2800 m.w., 3^{00} pm. 3 ♀: 21, 25, 25 mm. — **St. 176.** 49°31′ N, 11°25′ W. 31-8-1906. 300 m.w., 9^{30} pm., 120 min. 5 ♀: 25, 26, 27 (2 spec., 1 with ova), 30 mm. — **St. 178.** 48°04′ N,

12°40′ W. 2-9-1906. 300 m.w., 3^{15} am., 120 min. 1 ♀ 30 min. — **St. 178.** ibid. 1800 m.w., 9^{05} am. 2 ♀ 25 mm. — **St. 179.** 47°20′ N, 12°23′ W. 3-9-1906. 600 m.w., 0^{00} am. 2 ♀ 27—30 mm. — **St. 180.** 48°19′ N, 13°53′ W. 3-9-1906. 300 m.w., 3^{00} pm., 60 min. 1 ♀ with small embryos (abt. 1 mm). 28 mm. — **St. 190.** 46°30′ N, 7°00′ W. 11-9-1906. 2700 m.w., 8^{25} am. 1 ♀ 21 mm. — **St. 4.** 1-12-1908. 1500 m.w., 11^{45} am., 60 min. 2 ♀ 16—19 mm. — **St. 65.** 24-2-1909. 65 m.w., 6^{30} pm., 60 min. 2 ♀ 14—25 mm. — **St. 65.** ibid. 300 m.w., 7^{45} am., 120 min. 2 ♀ 7—8 mm. — **St. 65.** ibid. 600 m.w., 10^{00} am., 120 min. 41 spec.: 1 ♂ ad. 8 mm, 1 ♂ jun. 7 mm, 38 ♀: 1 ♀ 7 mm, 3 ♀ 8—9 mm, 28 ♀ 11—22 mm, 5 ♀ 24—25 mm, 1 ♀ 27 mm, 1 ♀ with ova 28 mm; 1 house. — **St. 66.** 25-2-1909. 65 m.w., 1^{45} am., 60 min. 3 ♀: 12, 15, 15 mm. — **St. 66.** ibid. 300 m.w., 2^{55} am., 120 min. 1 ♀ 28 mm. — **St. 69.** 1-3-1909. 25 m.w., 0^{30} am., 30 min. 6 spec.: 2 ♂ jun. 7 mm, 4 ♀: 8, 9, 14, 15 mm. — **St. 69.** ibid. 65 m.w., 10^{45} pm., 30 min. 15 spec.: 3 ♂ jun. 7 mm, 12 ♀: 2 ♀ 7 mm, 1 ♀ 10 mm, 6 ♀ 15—17 mm, 2 ♀ 19 mm, 1 ♀ with ova 30 mm. — **St. 69.** ibid. 300 m.w., 3^{05} pm., 30 min. 1 ♀ with ova 28 mm. — **St. 69.** ibid. 300 m.w., 11^{10} pm., 30 min. 33 spec.: 6 ♂ ad. 8 mm, 3 ♂ jun. 7 mm, 24 ♀: 4 ♀ 6—7 mm, 7 ♀ 8—10 mm, 6 ♀ 15 mm, 3 ♀ 20 mm, 4 ♀: 26, 27, 28, 30 mm (the last one with ova). — **St. 69.** ibid. 600 m.w., 9^{00} pm., 60 min. 3 ♀: 8, 21, 21 mm. — **St. 69.** ibid. 3000 m.w., 6^{30} pm., 60 min. 6 ♀: 14, 14, 16, 18, 23, 26 mm. — **St. 74.** 8-3-1909. 300 m.w., 10^{50} pm., 60 min. 1 ♀ 23 mm. — **St. 75.** 9-3-1909. 65 m.w., 9^{00} pm., 60 min. 1 ♀ 18 mm. — **St. 76.** 10-3-1909. 65 m.w., 6^{45} pm., 60 min. 1 ♀ 16 mm. — **St. 76.** ibid. 1600 m.w., 2^{40} pm., 60 min. 1 ♀ with ova 27 mm. — **St. 80.** 13-6-1910. 25 m.w., 11^{30} pm., 15 min. 1 ♀ 25 mm. — **St. 80.** ibid. 65 m.w., 10^{00} pm., 30 min. 1 ♀ 20 mm. — **St. 89.** 18-6-1910. 65 m.w., 3^{00} am., 15 min. 2 ♀ 11—17 mm. — **St. 89.** ibid. 300 m.w., 3^{25} am., 30 min. 4 spec.: 1 ♂ jun. 6 mm, 3 ♀: 10, 16, 21 mm. — **St. 89.** ibid. 1000 m.w., 4^{10} am., 30 min. 1 ♀ 31 mm, with embryos (2 mm) in its house. — **St. 91.** 18-6-1910. 300 m.w., 6^{55} pm., 45 min. 3 ♂ 7 mm: 1 jun., 2 ad. — **St. 91.** ibid. 1600 m.w., 5^{25} pm., 60 min. 2 spec.: 1 ♂ ad. 6 mm, 1 ♀ 24 mm. — **St. 95.** 23-6-1910. 300 m.w., 5^{10} am., 30 min. 1 ♀ 9 mm. — **St. 96.** 23-6-1910. 65 m.w., 9^{30} am., 30 min. 1 ♀ 8 mm. — **St. 240.** 15-9-1910. Surf. (P. 100), 9^{05} pm., 10 min. 1 ♀ 10 mm. — **St. 240.** ibid. 25 m.w., 8^{30} pm., 15 min. 11 ♀: 10 mm (3 spec.), 14, 16, 16, 17, 18 (3 spec.), 20 mm. — **St. 240.** ibid. 1000 m.w., 9^{40} pm., 30 min. 1 ♀ 26 mm. — **St. 242.** 16-9-1910. 65 m.w., 10^{55} pm., 30 min. 115 spec.: 1 ♂ ad. 8 mm, 27 ♂ jun. 7 mm., 64 ♀ 6—11 mm, 11 ♀ 14—16 mm, 10 ♀ 18—23 mm, 2 ♀ 24—25 mm. — **St. 244.** 17-9-1910. 1000 m.w., 10^{25} am., 30 min. 1 ♀ 28 mm. — **St. 245.** 17-9-1910. 65 m.w., 9^{55} pm., 15 min. 3 ♀: 23, 27, 27 mm. — **St. 245.** ibid. 150 m.w., 8^{55} pm., 15 min. 1 ♀ 28 mm. — **St. 245.** ibid. 400 m.w., 5^{15} pm., 120 min. 2 ♀ 28—30 mm, 3 houses and a few embryos (2 mm). — **St. 264.** 38°14′ N, 24°35′ W. 19-3-1911. 25 m.w. (S. 150), 7^{00} pm., 30 min. 2 ♀ 6—13 mm. — **St. 265.** 39°22′ N, 22°49′ W. 20-3-1911. 25 m.w. (S. 150), 7^{30} pm., 30 min. 1 ♂ jun. 7 mm. — **St. 265.** ibid. 47 m.w. (S. 100), 7^{00} pm., 30 min. 1 ♀ 13 mm. — **St. 267.** 42°37′ N, 18°06′ W. 22-3-1911. 47 m.w. (S. 100), 7^{00} pm., 30 min. 6 spec.: 2 ♂ jun. 5—7 mm, 4 ♀ 7, 7, 12, 14 mm. — **St. 268.** 45°44′ N, 13°20′ W. 24-3-1911. 25 m.w. (S. 150), 4^{30} am., 30 min. 1 ♂ jun. 6 mm. — **St. 268.** ibid. 47 m.w. (S. 100), 4^{30} am., 30 min. 2 spec.: 1 ♂ jun. 5 mm, 1 ♀ 8 mm. — **St. 376.** 34°41′ N, 16°41′ W. 22-7-1911. 15 m.w. (S. 200), 8^{15} pm., 30 min. 13 spec.: 4 ♂ jun. 6—7 mm, 9 ♀: 6 ♀ 7—9 mm, 3 ♀ 12, 13, 18 mm. — **St. 376.** ibid. 30 m.w. (S. 100), 8^{10} pm., 30 min. 12 spec.: 6 ♂ jun. 6—7 mm, 6 ♀: 8, 12, 15 (3 spec.), 18 mm. — **St. 382.** 34°21′ N, 16°24′ W. 23-10-1911. 22 m.w. (S. 100), 6^{05} pm., 30 min. 1 ♀ 14 mm. — **St. 398.** 36°48′ N. 14°22′ W. 26-10-1911. 56 m.w. (S. 150), 12^{40} am., 30 min, 2 spec.: 1 ♂ jun. 5 mm, 1 ♀ 22 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1910. Surf. (S. 200), 9^{10} pm., 30 min. 10 spec.: 1 ♂ jun. 5 mm, 9 ♀ 5—7 mm. — **St. 399.** ibid. 56 m.w. (S. 150), 9^{10} pm., 30 min. 4 ♀: 5, 6, 13, 13 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 10^{05} pm., 30 min. 1 ♂ jun. 7 mm. — **St. 400.** ibid. 56 m.w. (S. 150), 9^{35} pm., 30 min. 2 ♀ 5—16 mm.

The material from the "Thor" Exp. contains 1204 spec. (241 ♂, 888 ♀, about 75 jun.) from 134 st., 217 hauls. Somewhat more than half the specimens and nearly the two thirds of stations and hauls are from the Mediterranean.

A. Mediterranean.

	Stat.	Hauls	Specimens[1]		
			♂	♀	total
"Thor" Dec. 1908....	3	7	—	9	9
Jan. 1909....	11	20	8	92	100
Feb. —	10	13	6	45	51
June 1910....	4	9	15	36	51
July —	21	35	60	145	205
Aug. —	22	39	55	109	164
Sept. —	3	3	1	2	3
"Thor" total.....	74	126	145	438	583
other vessels.....	13	13	18	60	78
total...	87	139	163	498	661

Depths of the sea and occurrence.

The frequency of stations in percentage increases with the depth, and it has chiefly been taken at depths

Depths in w.	Total no of posit. st.	No. of posit. st. of the "Thor" alone	Total no. of st. of the "Thor"	Percentage of posit. st.
0— 500 ...	12	11	67	16.4
> 500—1000 ...	14	14	31	45.2
>1000—2000 ...	23	20	41	48.8
>2000—3000 ...	28	22	35	62.9
>3000 ...	10	7	10	70.0
total...	87	74	184	

of the sea > 500 m. The 12 stations of < 500 m have the

[1] The young found in the house of the mother are not included in these figures.

This is the second greatest number of stations and hauls for any kind of Hyperiidea from the "Thor" (only *Phrosina semilunata* has still higher figures).

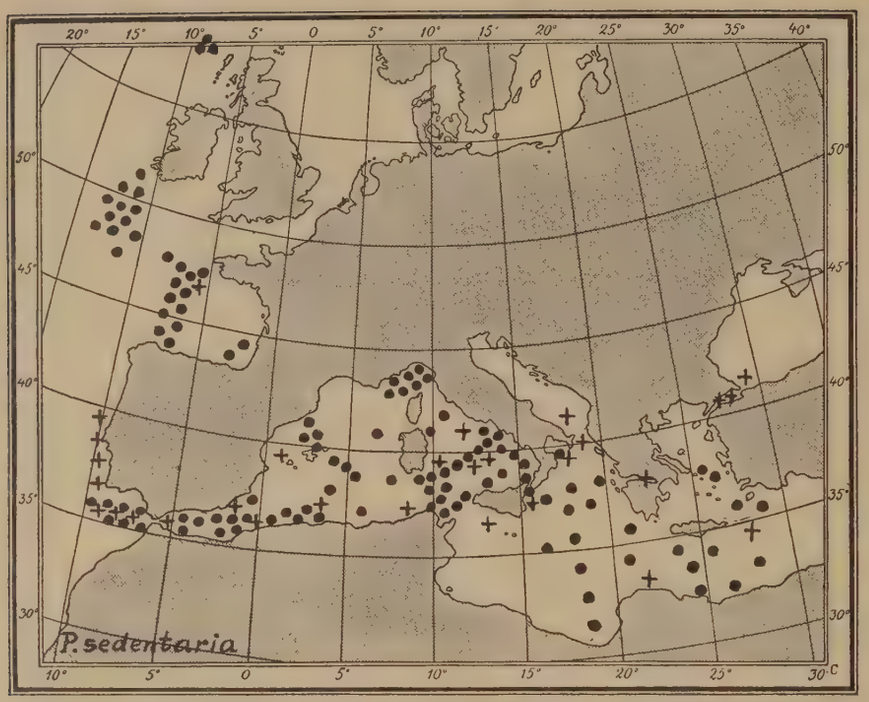

Chart 15. *Phronima sedentaria.* ● positive stations, + negative stations (> 500 m, night, 10—300 m.w.). St. 165 and 167 (1905) lie outside the chart to the N., stations posteriorly to st. 264 (1911) lie outside to the S.W. Some of the stations lie so close to each other that it was impossible to note them all.

following depths: 75 m (2 times), 85, > 100, 105, 150, 175—195, 200, 235, 365, 400, 450 m.

As regards the distribution, the 74 positive stations of the "Thor" itself lie 57 in the western, 17 in the eastern basin; the supplementary 13 stations are to be divided into 4 and 9 respectively, so that there are in all 61 stations in the western, 26 stations in the eastern basin. Reckoning only with depths > 500 m the figures for the "Thor" only become 50 and 16 respectively. Of negative stations (> 500 m, night-hauls 10—300 m. w.) there are 13 (it is abt. 20 per cent.) in the western, 12 (it is abt. 40 per cent.) in the eastern basin. In the western basin, the negative stations are evenly distributed among the positive ones, in the eastern there are in the Adriatic and inside the Dardanelles only negative stations.

Vertical occurrence. In winter it was taken at night at all depths, from the surface to > 400 m. w. during the day only with 65 m. w. or deeper down.

In summer, the depths at night are the same as in winter, but especially 300 m. w. (51 per cent. of all hauls on a depth of the sea of > 500 m); in the daytime only 300 m. w. or deeper down.

If, however, we look at the two sexes separately, the result is somewhat different.

During the winter (Dec.—Feb.), night, males were not taken at all at the very surface: 2 ♂ ad. 65 and 300 m.w. respectively, 9 (14) ♂ jun. 65—> 400 m.w.

During the summer, night, (June 25—Sept. 5) the young ♂ live both at the surface and deeper down, but the fullgrown ♂ were almost exclusively taken with 300—400 m. w., only exceptionally at the surface.

As to females (night) it appears that both in winter and summer the young specimens (5—20 mm) live both at the surface and deeper down; but the larger ones were nearly all taken with 300—400 m. w. The smallest (4—7 mm) were found chiefly at the very surface. What is here shown for ♀ is absolutely at variance with existing literature (see above p. 114). For ♀ with ova or embryos see under Propagation.

Size and propagation. ♂ ad. are as a rule 8 mm, rarely only 7 mm (Vosseler: 8—10 mm). In the Mediterranean, 3 times as many females as males were taken (498 and 163 respectively).

Females grow to 36 mm (Chun: 40 mm). Females of < 25 mm have as a rule no marsupial plates; large plates are as a rule only to be found on animals > 28 mm, the intermediary sizes have small marsupial plates. The strong spine on the end of the hind margin of the femur in p. 3—p. 5 becomes much smaller when the animals are about 15—20 mm long, and on p. 5 it projects in a sharp point; this Vosseler considers the chief character of the age of maturity, apart from the form of the chela in p. 5. On p. 19 he even says: "Die Weibchen besitzen alle Merkmale der Geschlechtsreife etwa bei 16 mm Körperlänge". Females of > 21 mm are most often a little harder-skinned than the smaller ones. The large ♀ (> ca. 20 mm) are comparatively much rarer in the Mediterranean than in the Atlantic.

It is only the large ♀, which are to be found in houses (see Minkiewicz l. c. No. 152, 1909). In the material of the "Thor" there are from the Mediterranean 13 spec. in houses; 1 spec. is 15 mm, the others (21) 22—36 mm; 6 of these females have neither ova nor embryos.

From the Mediterranean there are only 10 females with ova or young, and they have a size of 26—36 mm. ♀ with ova were found 6. April and 22. June—1. Aug.; ♀ with young 16. and 19. Jan. (the young 2—3 mm), 1. Aug. (the young 1 mm), 10. Aug. (the young 3—4 mm) and 29. Aug. (the young 0,75 mm [in the marsupium] or 3—4 mm [in the house]). When the young are 1 mm long they leave the marsupium and are fixed in two groups of about 100 each inside the house of the mother (see Minkiewicz l. c. 1909 (no. 152) fig. 22 p. 2), where they remain until they are about 4 mm long. The smallest free-living young are 4—5 mm. The old ♀ with young keep on a level answering at night to about 300 (400) m. w. (only one spec. 1000 m. w.); when the young leave the house of the mother, they rise, and during the night they are to be found at or rather near the surface; gradually they descend deeper and deeper. This is altogether at variance with the view current in literature (see above p. 114).

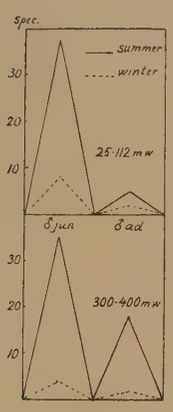

Fig. 50. ♂

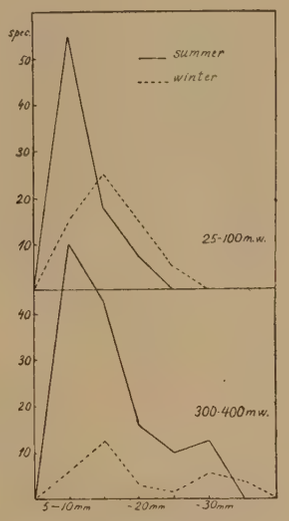

Fig. 51. ♀

Phronima sedentaria. Vertical occurence of ♂ (Fig. 50) and ♀ (Fig. 51) in the Mediterranean, night, summer (June 25th—Sept. 5th) and winter (Dec. 16th—Feb. 21st).

Lo Bianco records (1904 p. 43) that at Naples it is common at the surface, during the winter and the spring, in particular ♀ ad.; ♂ is much rarer, though it occurs all the year round, but only deeper down than 50 m (I suppose he means during the day?).

All the authors who have described *Phronima* (*sedentaria*) from the Mediterranean agree that the spawning season is the winter and spring (Lo Bianco 1909, p. 596: Nov.—April [Naples]; Woltereck, see p. 114), though it may also occur at other seasons (August; Lo Bianco 1909). Though the "Thor"-collections nevertheless seem to show that the season of propagation chiefly occurs during the summer, one must not overlook the fact, as also stated elsewhere, that the "Thor" itself made no collections at all in the Mediterranean from the end of February to the end of June. Therefore, the collections of the "Thor" do not signify that it does not propagate during the spring, but only that it can propagate during the summer (for the rest there are some single ♀ with ova or young from 16. and 19. Jan. and 6. April, the latter date is from one of the supplementary collections).

That the winter and spring constitute the proper season of propagation in the Mediterranean also seems probable an account of the distribution of the species, it being one of the species belonging to this family which penetrates furthest north in the Atlantic, as far as about 60° N. In spite of apparent contradiction one may safely specify the time of propagation in the following manner: South-west Ireland: summer and autumn; Bay of Cadiz and Mediterranean: winter and early spring; the Canaries: January (Chun), though it appears that the species can also propagate at other seasons. (It must be noted that the sizes of the specimens from the "Thor" tell us nothing as to growth and spawning time).

B. Atlantic.

From the Atlantic there are some 543 spec. (78 ♂, 390 ♀, about 75 juv.) from 47 stations, 78 hauls.

		St.	Hauls	Specimens			
				♂	♀	jun.	total
N. of 40° N	"Thor" June 1905	6	10	10	78	abt. 75	abt. 160
	Aug. —	3	5	1	15	—	16
	May 1906	3	3	—	5	—	5
	June —	5	7	—	21	—	21
	Aug. —	1	1	—	5	—	5
	Sept. —	4	5	—	7	—	7
	Dec. 1908	1	1	—	2	—	2
S. of 40° N	Feb. 1909	2	5	2	46	—	48
	March —	1	6	14	49	—	63
	— —	3	4	—	4	—	4
N of 40° N	June 1910	5	9	5	12	—	17
	Sept. —	4	8	28	106	—	134
	total	38	64	60	350	abt. 75	abt. 485
	other vessels	9	14	18	40	—	58
	total ...	47	78	78	390	abt. 75	abt. 543

Depths of the sea and occurrence.

The depth of the sea is on an average very great, > 1000 m; but the species can exceptionally be encount-

ered at much smaller depths. The 3 stations 0—500 m have the following depths: 190, 182—330 and 275 m.

The distribution is as follows: West of Shetland 2 stations (1905: St. 164—165) and 3 stations west of the Hebrides (1905: St. 70, 72, 167); the other stations from 1905—06 are off south-west Ireland or in the Bay of Biscay.

Depths in m	No. of posit. st.
0—500	3
> 500—1000	3
> 1000—2000	18
> 2000—3000	7
> 3000	16
total	47

The stations of the "Thor" itself from 1908—10 are in the Bay of Biscay or in the Bay of Cadiz; the supplementary collections originate from the waters south-west of the Bay of Cadiz.

Vertical occurrence.

M. w.	No. of hauls.							
	"Thor" 1905—06			"Thor" 1908—10				other vessels
				Winter 1908—09		Summer 1910		
	Night	Day	Hour not noted	Night	Day	Night	Day	Night
10—35(47)	—	—	—	1	—	3	—	11
50—100	—	—	2	5	—	4	1	3
150	—	—	—	—	—	1	—	—
300—400	7	4	1	3	2	3	—	—
500—800	1	2	—	1	1	—	1	—
> 800	3	5	2	1	2	2	2	—

In the northern waters (from 61° N to the Bay of Biscay) there are 2 hauls (hour not recorded) with 65 m. w.; otherwise it has not been taken, either day or night, nearer the surface than with 300 m. w.; it has also been taken very deep down (up to 2500 m. w.). From the Bay of Biscay to the Bay of Cadiz (there does not seem to be any difference between summer and winter) it has been taken during the night from the very surface to the greatest depths, during the day, with a single exception, (65 m. w., summer) not nearer the surface than with 300 m. w. In the southernmost area (south-west of the Bay of Cadiz) it has only been taken quite near the surface (night, 15—56 m. w.).

Size and propagation. The sizes are as in the Mediterranean (see p. 119).

In the northern area (from South-west Ireland and further north) apart from a number of quite small spec. (4—5 mm) hardly any spec. of less than 20 mm have been caught. During the period between 21. May—3. Sept. 12 ♀ with ova or young have been found within this area, sizes 26—33 mm and length of line 65—2000 m. w., most often 300 m. w. ♀ with ova alone have been found 21. May—10. June, and a single spec. 31. Aug. ♀ with embryos were found 13. June (embryos 4 mm) and 29. Aug.—3. Sept. (embryos 1—1,25 mm and 2 mm). The quite small specimens (4 mm) have been found 14. June, 300—600 m. w. From this it appears that it these waters the species propagates during the summer and early autumn. Tattersall (1906, p. 20) mentions from these waters some adult ♀ and several small specimens taken in Nov. with 75 fms. wire.

In the Bay of Biscay the "Thor" found on 17-9-1910 (St. 245) 400 m.w., day, a house with embryos (2 mm).

In the Bay of Cadiz, 1908—09 (but not 1910) from 24. Febr.—10. March, and with 65—300 m. w. night, 300—1600 m.w. daytime, 5 ♀ with ova have been taken, 27—31 mm; but 18-6-1910 with 1000 m. w. night, 1 ♀ has been taken, 31 mm, with embryos of 2 mm. In this southern area the spawning season thus probably occurs during the winter.

From the supplementary collections south-west of the Bay of Cadiz there are no females with ova or embryos; Chun (1895) gives the spawning season off the Canaries as January.

Distribution.

The distribution is given by Bovallius (Monograph: *P. sedentaria* + *P. spinosa*) as the Mediterranean, besides the temperate, subtropical and tropical regions of the three main Oceans. Apart from the northern regions of the Atlantic, the available data are in reality very insufficient.

1. Mediterranean, see above p. 117.

2. Atlantic. "Thor" see above. It is recorded from the northern Atlantic by a great number of writers. Apart from the "Thor" collections, the largest hitherto known material is from the German Plankton-Exp. (Vosseler 1901). From this there are 129 spec. (44 ♂, 85 ♀) from 49 hauls between 43,6° N (in the Gulf Current, 17.9° W) and 7.3° S; the length of wire is as a rule 400 m and the depth is otherwise between the surface and 700 m. A detailed list of additionary Atlantic localities see my paper l. c. 1923, p. 35. — The south limit in the Atlantic can not be given, it is hardly noted south of 7.3° S, 21.4° W (German Plankton-Exp.).—

3. Indian Ocean. Lion's Head (British S. Africa) SE$^1/_2$E distant 42 miles, 285 m (Stebbing, Ann. S. Afr. Mus., vol. 6, pt. 4, 1910, p. 475). — 5 miles NW of Des-

roches Island (Amirante); 10°27′ S, 51°17′ E; 8°16′ S, 51°26′ E; S. of Alphonse Island (abt. 7° S, 53° E); 4°16′ S, 71°53′ E; 3°31′ S, 72°27′ E; Salomon Atoll (abt. 7° S, 72° E) (Walker 1909). — Borneo (*P. Borneensis*; Bate 1862). — 50°1′ S, 123°4′ E, 1800 fms., 1 ♀ with ova (*P. novæ zealandiæ*?, Stebbing 1888).

4. Pacific. 36°23′ N, 174°31′ E (“*P. atlantica*” ♀), and 13°11′ N, 139°28′ E (Stebbing 1888). — 3°48′ S, 152°56′ W, surf.; ♂ (*P. tenella*, Stebbing 1888). — Common on east coast of Otago, New Zealand; Wellington (*P. neozelanica*; Thomson & Chilton, Trans. & Proc. New Zealand Inst. vol. 18, 1885 (1886), p. 150). — Sumner, New Zealand (*P. novæ-zealandiæ*; Powell, ibid. vol. 7, 1874 (1875), p. 294).

2 a. PHRONIMA ATLANTICA Guérin (Chart 16).

Phronima atlantica Bovallius 1889, p. 374 (lit.), Pl. 16 figs. 19—26. — **P. a.* Vosseler 1901, p. 21, Pl. 2 (lit.). — *P. sedentaria* ♀ Claus, Zur Naturgesch. von P. sedent. Forsk.; Zeitschr. Wiss. Zool. vol. 22, 1872, p. 331, textfigs. 2—3, Pl. 26, fig. 1, ♀ (not ♂; ♂ = *P. Colletti*) — ♂ ad. Chun, Das Männchen d. P. sedentaria, nebst Bemerkungen über die Phronima-Arten; Zool. Anzeiger vol. 12, 1889, p. 378 (not ♂ jun.; ♂ jun. = *P. sedentaria*). — *P. s.* ♂ ad. Chun, Bibliotheca Zoologica vol. 7, 1895, p. 111 seq., Pl. 7 fig. 1 etc. (not fig. 2), Pl. 8 fig. 7—9 (not ♂ jun.; ♂ jun. = *P. sedentaria*).

Mediterranean.

St. 10. 15-12-1908. 600 m.w., 3^{45} pm., 60 min. 1 ♂ jun. 5 mm. — **St. 11.** 16-12-1908. 65 m.w., 5^{25} am., 60 min. 3 spec.: 2 ♂ ad. 8 mm, 1 ♀ 9 mm. — **St. 11.** ibid. 300 m.w., 7^{00} am., 120 min. 1 ♂ ad. 8 mm. — **St. 13.** 19-12-1908. 15 m.w. 10^{15} pm., 60 min. 2 ♀ 11—13 mm. — **St. 26.** 19-1-1909. 300 m.w., 6^{40} am., 180 min. 1 ♂ jun. 8 mm. — **St. 39.** 1-2-1909. 1000 m.w. 0^{30} pm., 120 min. 1 ♀ 12 mm. — **St. 42.** 2-2-1909. 300 m.w., 9^{40} pm., 30 min. 1 ♀ 16 mm. — **St. 46.** 7-2-1909. 300 m.w., 7^{30} pm., 30 min. 1 ♂ jun. 6 mm. — **St. 59.** 21-2-1909. 500 m.w., 1^{40} am., 30 min. 1 ♂ jun. 6 mm. — **St. 99.** 23-6-1910. 300 m.w., 11^{25} pm., 30 min. 5 spec.: 2 ♂ jun. 6 mm, 3 ♀ 6—7 mm. — **St. 107.** 25-6-1910. 65 m.w., 9^{50} am., 15 min. 4 spec.: 3 ♂ jun. 6—7 mm, 1 ♀ 6 mm. — **St. 107.** ibid. 2000 m.w., 7^{30} am., 60 min. 1 ♂ jun. 6 mm. — **St. 112.** 27-6-1910. 25 m.w., 1^{30} am., 15 min. 1 ♀ 11 mm. — **St. 113.** 28-6-1910. 300 m.w., 3^{25} am., 30 min. 2 ♀ 6—14 mm. — **St. 115.** 29-6-1910. 65 m.w., 1^{20} am., 15 min. 1 ♂ jun. 6 mm. — **St. 115.** ibid. 300 m.w., 11^{20} pm., 30 min. 3 spec.: 1 ♂ jun. 6 mm, 2 ♀ 8—11 mm. — **St. 115.** ibid. 2000 m.w., 0^{30} am., 60 min. 1 ♀ 5 mm. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 13 spec.: 3 ♂ jun. 5 mm, 10 ♀ 5—6 mm. — **St. 116.** ibid. 300 m.w., 4^{05} pm., 30 min. 1 ♂ jun. 5 mm. — **St. 118.** 1-7-1910. 25 m.w., 0^{20} am., 15 min. 8 spec.: 4 ♂ jun. 5—6 mm, 4 ♀ 5 mm. — **St. 118.** 65 m.w., 11^{35} pm., 30 min. 32 spec.: 6 ♂ jun. 5 mm, 26 ♀ 5—6 mm. — **St. 118.** ibid. 300 m.w., 5^{55} pm., 30 min. 11 spec.: 5 ♂ jun, 5—6 mm, 6 ♀ 4—7 mm. — **St. 121.** 2-7-1910. 25 m.w., 3^{35} am., 30 min. 1 ♀ 6 mm. — **St. 123.** 3-7-1910. 25 m.w., 1^{50} am., 15 min. 2 spec.: 1 ♂ jun. 6 mm, 1 ♀ 10 mm. — **St. 123.** ibid. 65 m.w., 0^{55} am., 30 min. 43 spec.: 3 ♂ ad. 8 mm, 15 ♂ jun. 5—7 mm; 25 ♀: 6 ♀ 6 mm, 10 ♀ 8 mm, 9 ♀ 10—12 mm. — **St. 123.** ibid. 300 m.w., 0^{05} am., 30 min. 4 spec.: 2 ♂ jun. 7—8 mm, 2 ♀ 7—16 mm. — **St. 124.** 3-7-1910. 65 m.w., 3^{30} am., 90 min. 1 ♂ jun. 6 mm, 1 ♀ 13 mm. — **St. 129.** 12-7-1910. 25 m.w., 3^{00} am., 30 min. 1 ♂ jun. 5 mm, 1 ♀ 4 mm. — **St. 129.** ibid. 300 m.w., 3^{40} am., 30 min. 4 spec.: 1 ♂ jun. 7 mm, 3 ♀ 7, 7, 11 mm. — **St. 129.** ibid. 600 m.w., 8^{00} pm., 30 min. 4 spec.: 2 ♂ jun. 5—6 mm, 2 ♀ 8 mm. — **St. 129.** ibid. 3500 m.w., 3^{00} pm., 120 min. 4 ♀: 6, 6, 7, 10 mm. — **St. 130.** 13-7-1910. 25 m.w., 0^{50} am., 30 min. 4 spec.: 2 ♂ jun. 5 mm, 2 ♀ 4—7 mm. — **St. 131.** 13-7-1910. 300 m.w., 10^{35} am., 30 min. 6 spec.: 1 ♂ ad. 8 mm, 5 ♀ 7—11 mm. — **St. 131.** ibid. 1000 m.w., 11^{40} am., 60 min. 1 ♂ jun. 7 mm. — **St. 132.** 14-7-1910. 300 m.w., 3^{45} am., 30 min. 31 spec.: 3 ♂ ad. 7—8 mm, 6 ♂ jun. 5—7 mm, 22 ♀: 16 ♀ 6—7 mm, 6 ♀ 8—11 mm. — **St. 132.** ibid. 600 m.w., 4^{50} am., 30 min. 4 spec.: 2 ♂ jun. 5—7 mm, 2 ♀ 6—9 mm. — **St. 133.** 14-7-1910. 25 m.w., 11^{00} pm., 30 min. 1 ♀ 7 mm. — **St. 133.** ibid. 300 m.w., 10^{15} pm., 30 min. 43 spec.: 2 ♂ ad. 7 mm, 16 ♂ jun. 5—7 mm, 25 ♀: 21 ♀ 7—8 mm, 3 ♀ 9—10 mm, 1 ♀ with ova 12 mm. — **St. 133.** ibid. 600 m.w., 9^{20} pm., 30 min. 8 spec.: 1 ♂ ad. 7 mm, 2 ♂ jun. 6—7 mm, 5 ♀: 4 ♀ 8 mm, 1 ♀ 12 mm. — **St. 134.** 15-7-1910. 300 m.w., 5^{40} am., 30 min. 1 ♂ ad. 8 mm. — **St. 137.** 19-7-1910. 25 m.w., 8^{15} am., 30 min. 5 spec.: 3 ♂ jun. 5—7 mm, 2 ♀ 5 mm. — **St. 137.** ibid. 250 m.w., 9^{05} am., 30 min. 4 spec.: 1 ♂ ad. 7 mm, 3 ♀ 5—7 mm. — **St. 138.** 19-7-1910. 25 m.w., 9^{50} pm., 30 min. 5 spec.: 3 ♂ jun. 5—7 mm, 2 ♀ 4—7 mm. — **St. 138.** ibid. 300 m.w., 9^{10} pm., 30 min. 14 spec.: 2 ♂ ad. 7 mm, 5 ♂ jun. 5—6 mm, 3 ♀ 6 mm, 4 ♀ 8—11 mm. — **St. 138.** ibid. 1000 m.w., 7^{40} pm., 60 min. 1 ♀ 13 mm. — **St. 139.** 20-7-1910. 300 m.w., 2^{35} am., 30 min. 1 ♂ jun. 5 mm. — **St. 143.** 23-7-1910. 25 m.w., 1^{20} am., 30 min. 18 spec.: 2 ♂ jun. 6 mm, 2 ♂ ad. 7 mm, 14 ♀ 6—15 mm. — **St. 143.** ibid. 300 m.w., 0^{30} am., 30 min. 4 ♀ 12—15 mm. — **St. 144.** 24-7-1910. 25 m.w., 2^{00} am., 30 min. 10 spec.: 1 ♂ jun. 5 mm, 9 ♀: 3 ♀ 6—9 mm, 6 ♀ 11—15 mm. — **St. 144.** ibid. 300 m.w., 2^{45} am., 30 min. 1 ♀ 10 mm. — **St. 145.** 25-7-1910. 25 m.w., 3^{30} am., 30 min. 6 spec.: 2 ♂ ad. 7 mm, 4 ♀ 5—8 mm. — **St. 145.** ibid. 300 m.w., 4^{10} am., 30 min. 1 ♀ with ova 12 mm. — **St. 147.** 25-7-1910. 25 m.w., 11^{25} pm., 30 min. 7 spec.: 1 ♂ ad. 7 mm, 2 ♂ jun. 6 mm, 3 ♀ 6—8 mm, 1 ♀ with ova 14 mm. — **St. 147.** ibid. 300 m.w., 0^{20} am., 30 min. 1 ♂ jun. 5 mm. — **St. 147.** ibid. 1000 m.w., 1^{10} am., 60 min. 3 ♀: 7, 10, 17 mm. — **St. 152.** 27-7-1910. 25 m.w., 10^{50} pm., 15 min. 2 ♂ ad. 7 mm. — **St. 152.** ibid. 300 m.w., 11^{35} pm., 30 min. 1 ♀ 11 mm. — **St. 156.** 30-7-1910. 25 m.w., 2^{15} am., 30 min. 21 spec.: 7 ♂ ad. 7 mm, 3 ♂ jun. 6 mm, 11 ♀: 8 ♀ 7—10 mm, 3 ♀ 12, 14, 14 mm. — **St. 156.** ibid. 1000 m.w., 0^{40} am., 60 min. 4 ♀ 5, 7, 9, 12 mm. — **St. 160.** 1-8-1910. 25 m.w., 2^{00} am., 30 min. 1 ♂ jun. 5 mm, 1 ♀ 10 mm. — **St. 160.** ibid. 300 m.w., 2^{45} am., 30 min. 1 ♀ 10 mm. — **St. 160.** ibid. 1000 m.w., 3^{35} am., 60 min. 1 ♀ 9 mm. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 5 spec.: 1 ♂ ad. 7 mm, 3 ♂ jun. 5—6 mm, 1 ♀ 6 mm. — **St. 163.** 3-8-1910. 300 m.w., 1^{05} am., 15 min. 4 ♀ 6—9 mm. — **St. 178.** 12-8-1910. 65 m.w., 0^{20} am., 15 min. 6 spec.: 2 ♂ jun. 6 mm, 4 ♀ 6—11 mm. — **St. 181.** 13-8-1910. 300 m.w.,

1^{25} pm., 20 min. 1 ♀ 6 mm. — **St. 182.** 13-8-1910. 10 m.w., 11^{00} pm., 15 min. 3 spec.: 2 ♂ ad. 6—7 mm, 1 ♀ 9 mm. — **St. 183.** 16-8-1910. 65 m.w., 5^{10} pm., 15 min. 1 ♀ jun. 3 mm. — **St. 183.** ibid. 300 m.w., 4^{25} pm., 15 min. 8 spec.: 4 ♂ ad. 7 mm, 1 ♂ jun. 5 mm, 2 ♀ 10—14 mm. 1 ♀ 7 mm. — **St. 186.** 17-8-1910. 10 m.w., 11^{30} pm., 15 min. 10 spec.: 4 ♂ ad. 7 mm, 2 ♂ jun. 5—6 mm, 4 ♀ 7, 7, 8, 12 mm. — **St. 187.** 18-8-1910. 25 m.w., 7^{45} pm., 30 min. 7 spec.: 2 ♂ jun. 6—7 mm, 5 ♀: 6, 6, 8, 9, 12 mm. — **St. 190.** 19-8-1910. 25 m.w., 8^{15} pm., 15 min. 1 ♀ 11 mm. — **St. 193.** 21-8-1910. 10 m.w., 0^{50} pm., 30 min. 1 ♀ 10 mm. — **St. 194.** 21-8-1910. 10 m.w., 4^{30} am., 15 min. 4 spec.: 2 ♂ ad. 7 mm, 2 ♀ 6—7 mm. — **St. 194.** ibid. 25 m.w., 5^{00} am., 15 min. 4 spec.: 2 ♂ jun. 5—6 mm, 2 ♀ 6—8 mm. — **St. 195.** 21-8-1910. 65 m.w., 6^{50} pm., 15 min. 1 ♂ ad. 7 mm. — **St. 196.** 22-8-1910. 25 m.w., 2^{40} am., 30 min. 9 spec.: 1 ♂ ad. 7 mm, 5 ♂ jun. 6—7 mm, 3 ♀ 6—7 mm. — **St. 197.** 24-8-1910. 25 m.w., 7^{45} pm., 15 min. 6 spec.: 1 ♂ ad. 7 mm, 1 ♂ jun. 6 mm, 4 ♀ 6—10 mm. — **St. 199.** 25-8-1910. 1000 m.w., 10^{10} pm., 30 min. 2 ♀ (1 with ova) 13 mm. — **St. 200.** 26-8-1910. 25 m.w., 3^{45} am., 30 min. 12 spec.: 4 ♂ ad. 7 mm, 2 ♂ jun. 6—7 mm, 6 ♀: 4 with ova 11—14 mm, 1 with embryos 12 mm, 1 without ova or embr. 10 mm. — **St. 202.** 26-8-1910. 300 m.w., 5^{05} pm., 15 min. 1 ♂ ad. 7 mm. — **St. 204.** 27-8-1910. 25 m.w., 4^{00} am., 15 min. 8 spec.: 2 ♂ jun. 6 mm, 6 ♀: 6, 6, 8, 11, 11, 15 mm. — **St. 204.** ibid. 65 m.w., 4^{30} am., 15 min. 6 spec.: 3 ♂ jun. 5—6 mm, 3 ♀ 7—9 mm. — ?**St. 204.** ibid. 300 m.w., 5^{00} am., 30 min. 1 ♂ ad. 7 mm. — **St. 206.** 28-8-1910. 25 m.w., 0^{30} am., 15 min. 1 ♀ with ova 14 mm. — **St. 206.** ibid. 1000 m.w., 1^{45} am., 45 min. 2 ♀ 6 mm. — **St. 207.** 29-8-1910. 1000 m.w., 6^{00} am., 45 min. 1 ♀ 8 mm. — **St. 208.** 29-8-1910. 25 m.w., 1^{40} am., 15 min. 5 spec.: 1 ♂ ad. 8 mm, 1 ♂ jun. 6 mm. 3 ♀ 6—8 mm. — **St. 209.** 29-8-1910. 25 m.w., 4^{55} am., 15 min. 1 ♂ jun. 5 mm, 1 ♀ 4 mm. — **St. 209.** ibid. 100 m.w., 3^{45} pm., 20 min. 9 spec.: 2 ♂ ad. 7—8 mm, 4 ♂ jun. 6—7 mm, 3 ♀ 6 mm. — **St. 209.** ibid. 150 m.w., 4^{25} pm., 20 min. 6 spec.: 1 ♂ ad. 7 mm, 3 ♂ jun. 6—7 mm, 2 ♀ 6—7 mm. — **St. 209.** ibid. 2000 m.w., 7^{25} am., 45 min. 2 ♀ 6 mm. — **St. 210.** 30-8-1910. 25 m.w., 2^{45} am., 30 min. 7 spec.: 3 ♂ jun. 6—7 mm, 4 ♀ 6—14 mm. — **St. 210.** ibid. 600 m.w., 3^{35} am., 30 min. 6 spec.: 1 ♂ ad. 7 mm, 1 ♂ jun. 7 mm, 2 ♀ 8—11 mm, 2 ♀ with ova 14 mm. — **St. 215.** 31-8-1910. 25 m.w., 9^{20} pm., 30 min. 3 spec.: 1 ♂ jun. 5 mm., 2 ♀ 7—9 mm. — **St. 223.** 5-9-1910. 25 m.w., 4^{25} am., 15 min. 1 ♀ 9 mm. — **St. 227.** 6-9-1910. 25 m.w., 5^{35} pm., 30 min. 1 ♀ 7 mm. — **St. 276.** 36°30′ N, 19°20′ E. 4-4-1911. 132 m.w. (S. 200), 11^{20} pm., 35 min. 13 spec.: 2 ♂ jun. 5 mm, 10 ♀ 4—6 mm, 1 ♀ 8 mm. — **St. 277.** 33°20′ N, 27°30′ E. 6-4-1911. 132 m.w. (S. 200), 11^{00} pm., 35 min. 11 spec.: 1 ♂ ad. 7 mm, 4 ♂ jun. 6—7 mm, 5 ♀ 5—7 mm, 1 ♀ 10 mm. — **St. 278.** 38°11.5′ N, 15°37.5′ E. 22-2-1911. 15 m.w. (S. 100), 1^{00} pm., 140 min. 3 spec.: 1 ♂ jun. 6 mm, 2 ♀ 4 mm. — **St. 281.** 38°15′ N, 15°37.5′ E. 1-3-1911. 10 m.w. (S. 100), 4^{55} pm., 60 min. 1 ♀ 12 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 6^{10} pm., 60 min. 1 ♀ 5 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 7^{50} pm., 60 min. 1 ♀ 8 mm. — **St. 282.** 38°12′ N, 15°37′ E. 8-3-1911. 40 m.w. (S. 100), 1^{45} am., 180 min. 5 spec.: 3 ♂ jun. 5 mm, 2 ♀ 8—16 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 2^{00} pm., 90 min. 1 ♂ ad. 8 mm, 2 ♂ jun. 6—7 mm. — **St 282** ibid. 40 m.w. (S. 100), 5^{30} pm., 90 min. 1 ♀ 16 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 7^{15} pm., 90 min. 7 spec.: 2 ♂ jun. 5—6 mm, 3 ♀ 4—5 mm, 2 ♀ 10—11 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 8^{45} pm., 90 min. 2 ♀ 5—7 mm. — **St. 282.** ibid. 40 m.w. (S. 100) 9^{00} pm., 90 min. 11 spec.: 1 ♂ ad. 8 m m,6 ♂ jun. 5—7 mm, 4 ♀: 5, 11, 14, 16 mm. — **St. 283.** (= 282). 12-3-1911. 40 m.w. (S. 100), 6^{30} pm., 180 min. 7 spec.: 1 ♂ ad. 7 mm, 6 ♂ jun. 6—7 mm. — **St. 283.** ibid. 40 m.w. (S. 100), 9^{30} pm., 180 min. 6 spec.: 1 ♂ jun. 5 mm, 5 jun. 2—4 mm. — **St. 283.** ibid. 40 m.w. (S. 100), 0^{45} am., 180 min. 3 spec.: 1 ♂ ad. 8 mm, 1 ♂ jun. 7 mm, 1 ♀ 7 mm. — **St. 297.** 33°10′ N, 25°35′ E. 25-6-1911. 25 m.w. (S. 200), 11^{30} pm., 30 min. 55 spec.: 1 ♂ ad. 6 mm, 14 ♂ jun. 6—7 mm, 40 ♀ 7—13 mm (2 with ova, 1 with embryos 11 mm). — **St. 298.** 34°20′ N, 21°10′ E. 26-6-1911. 38 m.w. (S. 200), 11^{30} pm., 30 mm. 92 spec.: 7 ♂ ad. 7 mm, 33 ♂ jun. 6—7 mm, 52 ♀ 7—13 mm (3 with ova 12 mm). — **St. 339.** 40°30′ N, 3°10′ E. 20-8-1911. 28 m.w. (S. 200), 3^{00} am., 30 min. 3 spec.: 1 ♂ jun. 5 mm, 2 ♀ 6 mm. — **St. 340.** 35°50′ N, 21°30′ E. 26-8-1911. 28 m.w., 9^{00} pm. 5 spec.: 2 ♂ jun. 5 mm, 3 ♀ 6—10 mm. — **St. 340.** ibid. 108 m.w., 9^{00} pm., 30 min. 13 spec.: 4 ♂ jun. 5—6 mm, 7 ♀ 4—6 mm, 2 ♀ 8—9 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 6 spec.: 2 ♂ jun. 6 mm, 3 ♀ 5, 5, 10 mm, 1 ♀ with ova 13 mm. — **St. 412.** 34°33′ N, 24°15′ E. 7-1-1912. 112 m.w. (S. 150), 2 ♂ jun. 5—6 mm. — **St. 698.** 37°20′ N, 9°25′ E. 25-2-1913. 5^{00} am. 6 spec.: 1 ♂ jun. 5 mm, 3 ♀ 16—18 mm, 2 ♀ with ova 14 mm. — **St. 699.** 36°00′ N, 18°58′ E. 7-2-1913. 5^{00} am. 1 ♀ 6 mm. — **St. 729.** 41°00′ N, 17°44′ E. 14-4-1913. 8 spec.: 3 ♂ jun. 4—6 mm, 3 ♀ 4—8 mm, 2 ♀ 10—14 mm.

Atlantic.

St. 4. 1-12-1908. 1500 m.w., 11^{45} am., 60 min. 1 ♀ 8 mm. — **St. 62.** 22-2-1909. 25 m.w., 9^{10} pm., 30 min. 1 ♀ 11 mm. — **St. 65.** 24-2-1909. 25 m.w., 5^{50} am., 30 min. 1 ♀ 15 mm. — **St. 65.** ibid. 65 m.w., 6^{30} am., 60 min. 8 ♀: 11, 11, 13, 15, 16, 16; 2 with ova 15—17 mm. — **St. 65.** ibid. 600 m.w., 10^{00} am., 120 min. 1 ♂ ad. 9 mm, 1 ♂ jun. 7 mm. — **St. 65.** ibid. 1600 m.w., 0^{30} pm., 120 min. 3 spec.: 1 ♂ jun. 7 mm, 2 ♀ 7—15 mm. — **St. 66.** 25-2-1909. 1200 m.w., 8^{30} am., 120 min. 2 spec.: 1 ♂ jun. 6 mm, 1 ♀ 16 mm. — **St. 69.** 1-3-1909. 25 m.w., 0^{30} am., 30 min. 2 spec.: 1 ♂ jun. 7 mm, 1 ♀ 12 mm. — **St. 69.** ibid. 65 m.w., 10^{45} pm., 30 min. 11 spec.: 2 ♂ ad. 8—9 mm, 4 ♂ jun. 7 mm, 5 ♀: 7, 7, 11, 11, 13 mm. — **St. 69.** ibid. 300 m.w., 11^{40} pm., 30 min. 12 ♀: 9 ♀ 6—12 mm, 1 ♀ 15 mm, 2 ♀ with ova 15—16 mm. — **St. 69.** ibid. 300 m.w., 3^{05} pm., 30 min. 5 spec.: 1 ♂ ad. 9 mm, 1 ♂ jun. 9 mm, 2 ♀ 7—12 mm. — **St. 69.** ibid. 600 m.w., 9^{00} pm., 60 min. 12 spec.: 2 ♂ jun. 7 mm, 9 ♀ 5—8 mm, 1 ♀ 13 mm. — **St. 87.** 17-6-1910. 65 m.w., 4^{40} pm., 15 min. 1 ♂ ad. 6 mm. — **St. 89.** 18-6-1910. 65 m.w., 3^{00} am., 15 min. 3 spec.: 1 ♂ jun. 5 mm, 2 ♀ 7—8 mm. — **St. 91.** 18-6-1910. 300 m.w., 6^{55} pm., 45 min. 3 spec.: 1 ♂ jun. 5 mm, 2 ♀ 4—8 mm. — **St. 92.** 19-6-1910. 65 m.w., 3^{40} am., 30 min. 1 ♀ 8 mm. — **St. 232.** 9-9-1910. 25 m.w., 8^{50} pm., 30 min. 2 ♀ 10—13 mm. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 8^{15} pm., 30 min. 33 spec.: 2 ♂ ad. 8 mm, 7 ♂ jun. 5—7 mm, 24 ♀ 6—12 mm. — **St. 376.** ibid. 30 m.w. (S. 100), 8^{10} pm., 30 min. 43 spec.: 3 ♂ ad. 8 mm, 12 ♂ jun. 6—7 mm, 27 ♀ 5—12 mm, 1 ♀ with ova 16 mm. — **St. 377.** 31°23′ N. 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 8^{05} pm., 30 min. 15 spec.: 6 ♂ jun. 6—7 mm, 1 ♂ ad. 8 mm, 1 ♀ 5 mm, 7 ♀ 8—10 mm. — **St. 382.** 34°21′ N, 16°24′ W. 23-10-1911. 22 m.w. (S. 100), 6^{05} pm., 30 min. 15 spec.: 1 ♂ ad. 8 mm, 4 ♂ jun. 7—8 mm, 10 ♀ 8—9 mm. — **St. 383.**

37°16′ N, 14°09′ W. 23-10-1911. 300 m.w. (S. 100), 6^{30} pm., 30 min. 4 ♀ 8—10 mm. — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. 56 m.w. (S. 100), 12^{40} am., 30 min. 1 ♀ 12 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. 18 ♀ 5—9 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 10^{05} pm., 30 min. 6 ♀ 13—15 mm. — **St. 400.** ibid. 56 m.w. (S. 150), 9^{35} pm., 30 min. 2 ♀ 6—10 mm.

The "Thor" material comprises 992 spec. (368 ♂, 619 ♀, 5 jun.) from 92 stations, 147 hauls; four-fifths of the yield is from the Mediterranean.

A. Mediterranean.

As appears from the subjoined table, it belongs to the most frequently occurring species, even though the individual hauls have upon the whole not yielded particularly large numbers (on an average 6—7 spec. per haul). A number of hauls have, however, yielded about 25—55 spec., a single one even 92.

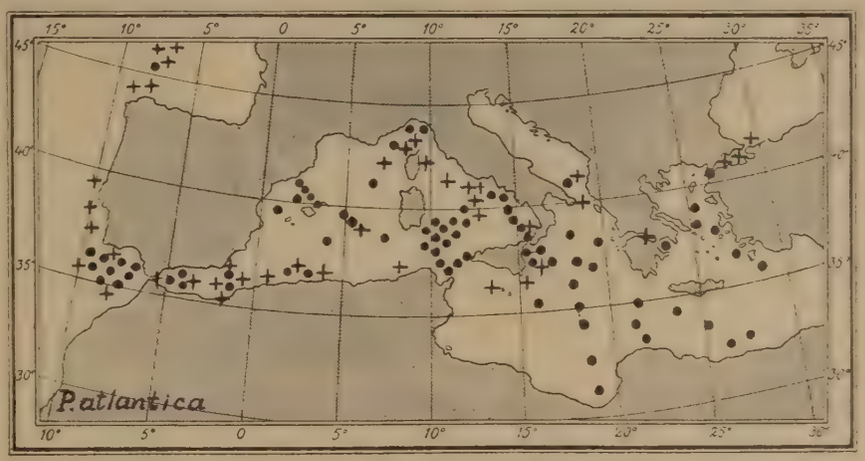

Chart 16. *Phronima atlantica*. ● positive, + negative stations. St. 376—400 lie outside the chart to the South West. Several of the stations lie so close to each other that it was impossible to note them all.

	No. of stat.	No. of hauls	No. of specimens ♂	♀	jun.	total
"Thor" Dec. 1908...	3	4	4	3	—	7
Jan. 1909...	1	1	1	—	—	1
Feb. — ...	4	4	2	2	—	4
June 1910...	6	10	12	20	—	32
July — ...	19	40	116	209	—	325
Aug. — ...	25	36	67	82	—	149
Sept. — ...	2	2	—	2	—	2
"Thor" total	60	96	212	308	—	520
other vessels	15	25	103	158	5	266
total...	75	121	315	466	5	786

Depths of the sea and occurrence.

Depths in m.	Total no. of posit st.	No. of posit. st. of the "Thor" alone	Total no. of st. of the "Thor"	Percentage of posit st.
0— 500...	14	10	67	14.4
> 500—1000...	15	13	31	41.9
> 1000—2000...	16	16	41	39.0
> 2000—3000...	19	14	35	40.0
> 3000...	11	7	10	70.0
total...	75	60	184	

Through the species chiefly keeps to depths > 500 m it is, however, comparatively frequent at much smaller depths: in the Straits of Messina it has been taken once at 5—8 m but otherwise the depths on less than 500 m vary between 68—480 m.

In the western basin the "Thor" itself has 41 stations (with the supplementary collections 43 stations); for the eastern basin, the figures are 19 and 32. Reckoning only depths of the sea > 500 m the "Thor" itself in has the western basin 36 positive stations against 23 negative ones (night, 0—300 m. w., > 500 m), in the eastern basin 15 positive against 10 negative; there are thus in both basins about $1^1/_2$ times as many positive as negative stations. The numerous occurrences in the eastern basin are quite unexpected; the distribution in the Mediterranean can indeed hardly be determined from the literature owing to the confusion with *P. sedentaria* and perhaps with still more species. Vosseler (in Lo Bianco 1903—04, p. 278) records it from 16 hauls 6. Feb.—8. April during the day, only at Naples with the exception of 1 haul between Capo Corso and Monaco, and 1 haul at Salina (Æolian Isles); the length of line is (100) 500—2500 m. w. but 2 hauls are made with a closing net 50 and 1000 m. w.

Vertical occurrence. In winter it was taken during the night in 5 hauls in all, 15—500 m. w., during the day in 4 hauls 300—1000 m. w.; in all only in 12 spec., thus only 1.3 spec. per haul.

In summer it has not been taken by day nearer the surface than with 65 m. w. At night, on the other hand, it was taken in 31 hauls, at the very surface; taking the average number of individuals per normal haul (of 30 min.) it appears that it is practically only found from

the surface to a depth answering to 300—400 m. w., thus the deeper hauls are nearly all from stations where the species was also taken nearer the surface, so that they undoubtedly result from the hauling in. The greatest

M. w.	Summer 1910, depths > 500 m					
	Night					Day
	No. of posit. hauls	Total no. of hauls "Thor"	Percentage of posit. hauls	No. of spec. (normal hauls of 30 min.)	Average no. of spec. (normal hauls of 30 min.)	No. of posit. hauls
10— 35	31	67	41.7	254	8.3	—
50—100	6	35	11.4	93	15.5	2
150—250	—	6	0	—	—	1
300—400	17	49	34.7	124	7.3	4
>400	12	46	26.1	34	2.8	4
total...	66	203	—	—	—	11

number of individuals per haul was taken with a length of wire of 50—100 m; but as there are in all only 6 hauls at this depth, the figure is perhaps accidental.

Taking each sex by itself, the "Thor" has not taken ♂ ad. in summer, day, nearer the surface than with 100 m. w, ♂ juv. on the other hand up to the very surface. For ♂ ad. the prevailing depth seems to be 300 m. w., for ♂ juv. 65 m. w.

In the summer at night, on the other hand, ♂ ad. seems most numerous at the very surface, while ♂ juv. has the greatest average per haul with 50—100 m. w., both occur very sparsely deeper down than at a depth answering to 300—400 m. w.

During the summer (night) the larger ♀ seem to prefer the deeper water layers; the day hauls are too few to indicate anything. As to ♀ with ova or young see under "Propagation".

Size and propagation. ♂ ad. is as a rule 8 mm, and there are $1^1/_2$ times as many ♀ as ♂ (466 and 315 respectively).

♀ is up to 17 mm, rarely more than 15 mm (Vosseler records 19 mm, Bovallius 25 mm). During the summer (25. June—30. Aug.) 16 ♀ with ova were found, 11—14 mm, all taken at night. The depths are 25—38 m. w. (11 spec.), 300 m. w. (2 spec.), 600 m. w. (2 spec.) and 1000 m. w. (1 spec.). Further, on 9. Nov. 1 ♀ (13 mm) with ova was taken with 122 m. w. night, and 25. Feb. 2 spec. (14 mm; m. w.?). There are in all only 2 ♀ with embryos, 11—12 mm long, both taken at night with 25 m. w.; the one specimen was taken on 25. June; the other on 26. Aug. ♀ with ova and young thus chiefly keep near the surface, in contrast to *P. sedentaria* (p. 109).

Vosseler gives it as mature on attaining a size of 14—15 mm, which agrees very well with the "Thor" collections. ♀ in houses were not found.

Though the species, as will be seen, can propagate during the winter, the greater number of females with ova and young have, however, been taken during the summer, but in spite of that it must not be considered a foregone conclusion that the summer is the proper spawning season. (The sizes of the "Thor" specimens indicate nothing as to growth and propagation.) Data as to the season of propagation which can with absolute certainty be referred to this species I have not been able to find in existing literature, apart from the statement of Vosseler (l. c. p. 26) of having found 8 ♀ (16—19 mm) with strongly developed marsupiums at Naples on 24. March (his statement on Chun 1895 is erroneous). The most likely supposition is, I presume, that it propagates all the year round, though hardly as much in winter as during the other seasons; this would in any case agree very well with its distribution in the Atlantic, where it has only been encountered a few times north of 36° N (see under "Distribution"), and it would correspond well with *P. sedentaria*, which, being a more northerly species, hardly propagates as strongly during the summer, as during the winter and spring. However, as far as both of those species are concerned, a much more extensive material is required in order to give a definite result.

B. Atlantic.

	Stat.	Hauls	No. of specimens		
			♂	♀	total
"Thor" Dec. 1908.....	1	1	—	1	1
Jan. 1909.....	3	6	3	13	16
March—	1	5	11	31	42
June —	4	4	3	5	8
Sept. —	1	1	—	2	2
"Thor" total	10	17	17	52	69
other vessels.....	7	9	36	101	137
total...	17	26	53	153	206

On an average, only a few specimens per haul have been taken, but as in the Mediterranean larger shoals, 33—43 spec., have been found. The supplementary collections south-west of the Bay of Cadiz yielded much larger results (137 spec., 9 hauls) than the collections of the "Thor" itself in the Bay of Cadiz (69 spec., 17 hauls).

Depths of the sea and occurrence. The depth is as in the Mediterranean. All the stations of the "Thor"

itself lie in the Bay of Cadiz, with the exception of St. 4 (Bay of Biscay), all the supplementary stations further towards the south-west. The normal northern limit seems to lie in the Bay of Cadiz; north of this it has only been taken 3 times in all *viz.* 52°27′ N, 15°40′ W, 1170 fms. and 52°4.5′ N, 12°27′ W, 376 fms. and ?620 fms. (Walker 1903, p. 230) and "Thor" Station 4 (in the Bay of Biscay). It is not recorded by Tattersall from SW. Ireland, and it is evidently a more southerly species than *P. sedentaria*.

Vertical occurrence. At night, the species has chiefly been taken at the surface, the hauls decreasing downward; only 1 haul is deeper than 300 m. w. During the day, it has not been taken nearer the surface than with 65 m. w.

m. w.	No. of hauls	
	Night	Day
10—35	10	—
56—65	5	2
300	3	1
> 400	1	4
	19	7

Propagation. 5 ♀ with ova (15—17 mm) have been found: 2 specimens with 65 m. w. day time, 24. Feb. 1 spec. with 30 m. w. night, 22. July, and 2 spec. with 300 m. w. 1. March. It can thus propagate both during summer and winter. Reliable data as to time of propagation are not to be found in extant literature; the German Plankton-Exp. gives no actual information, though Vosseler quotes some reflections on the subject.

Distribution.

1. Mediterranean, see above.

2. Atlantic. On the "Thor" and the northern limit at Europe, see above. The northern limit in the middle of the Atlantic is 41.6° N, 56.3° W (Vosseler l. c. 1901); the southern limit is abt. 40° S (the collections in our Museum).

The German Plankton-Exped. (Vosseler 1901) has taken 107 spec. (38 ♂ of which 5 ad., and 69 ♀, of which 5 ad.), at the following 33 st.: Florida-Current 2 st. 41.6° N, 56.3° W, 0—200 m and surf.; Sargasso-Sea 4 st.: 34.7° N, 62.4° W to 31.2° N, 56.4° W, surf., and 31.5° N, 40.7° W, 0—400 m; N. Equatorial-Current 7 st.: 28.9° N, 35° W, to 18.9° N, 26.4° W, and 10.2° N, 22.2° W, surf. or 0—400 m; Guinea-Current 4 st.: 7.9° N, 21.4° W to 2.9° N, 18.4° W, and 9.4° N, 41.9° W, 0—400 (0—200) m; S. Equatorial-Current 16 st.: 1.7° N, 17.3° W to 5.1° S, 14.1° W, 6.8° N, 14.2° W to 7.5° S, 20.3° W, and 5.3° S, 27 6° W to 0.4° S, 42.4° W, surf., 0—200 to 0—600 m.

Our Museum possesses specimens from the following localities: 35° N, 27° W, Hygom 1860; 27° N, 27° W and 26° N, 28° W, Andrea 1864; 24°—25° N, 31°—33° W, Iversen 1871; 18°—21° N, 36°—30° W, Andrea 1872; 7°37′ N, 22°26′ W, Reinhardt; 34° S, 36° W, Andrea; 34°20′—40° S, 5°30′—8°50′ W, and 37°30′ S, 10°40′ E, Andrea 1864; 38° S, 12° E, Andrea 1872; 38°20′ S, 30° W, Andrea 1864. — 7°—8° N, 24° W (Dana 1852).

3. Indian Ocean. I have not found localities in the literature, but our Museum has specimens from the following localities: 37° S, 29° E; 38°20′ S, 30° E; 39°56′ S, 40°26′ E; 39°50′ S, 41°30′ E; 36°50′ S, 50°30′ E; 28°16′ S, 97°30′ E—29°40′ S, 96°20′ E; all were collected by Capt. Andrea.

4. Pacific. China Sea (Vosseler l. c. 1901, p. 26). — 16° N, 115°20′ E, Andrea 1869 (our Zool. Mus.). — 37° N to 30°42′ S, 81°40′ to 160°25′ W (Streets 1882—83). — Chile (*"P. sedentaria"* ♀, Claus 1872).

2. b. PHRONIMA ATLANTICA Guér. var. SOLITARIA Guér.

Phronima solitaria Guérin-Méneville, Iconographie du Règne Animal de Cuvier, Crust., 1836, p. 21. — **P. megalodous* Stebbing, 1888, p. 1353, Pl. 162 fig. A. — *P. solitaria* Bovallius, 1889, p. 372, Pl. 16 fig. 4—7. — **P. atlantica* var. *solitaria* Guér. Vosseler, 1901, p. 23, Pl. 2 fig. 5.

Mediterranean.

St. 115. 1800 m. 29-6-1910. 25 m.w., 1^{40} am., 15 min. 1 ♀ jun. 10 mm.

P. custos Risso 1816 is by Vosseler with a ? considered synonymous with this species, but by Bovallius 1889 synonymous with *P. sedentaria*. Bovallius seems to be right, on account of the long carpal process in p. 5 and the large prolongation of the hind corners of the epimeral parts of the metasome segments (Risso Pl. 2 fig. 3). Only ♀ is known.

Distribution. "The subtropical and tropical regions of the Atlantic; the Indian Ocean" (Bovallius l. c.).

1. Mediterranean. "Thor" st. 115; the species is new to this Sea.

2. Atlantic. Our Zool. Mus. has specimens from the following localities: 18°—21° N, 36°30′ W, Andrea 1872; 15°19′ N, 24°54′ W, Reinhardt; 13°10′ N, 27°03′ W, Andrea 1869 (Bovallius det.); 1° N, 29° W, Andrea 1866 (Bovallius det.); 8° S, 13°20′ W, Andrea 1864 (Bovallius det.). — 16°49′ N, 24°14′ W, surf., night, 1 ♀ (Stebbing l. c.). — The German Plankton Exped. (Vosseler 1901) had 4 ♀ from the following 3 localities, 0—400 m: 2.9° N, 18.4° W; 1.1° N, 16.4° W, and 4.1° S,

14.2° W. — "Assez loin de l'embouchure de la Plata" (Guérin l. c.).

3. Indian Ocean. Without special locality (Bovallius l. c.).

4. Pacific. ?17°29′ N, 141°21′ E, 1 ♀ (Stebbing, l. c.).

3. PHRONIMA CURVIPES Voss.
(Fig. 53, chart 17).

?*Phronima curvipes* Vosseler, 1901, p. 27, Pl. 3 fig. 1—3.

Mediterranean.

St. 46. 7-2-1909. 300 m.w., 7^{30} pm., 30 min. 1 ♀. — **St. 47.** 10-2-1909. 300 m.w., 11^{05} pm., 30 min. 1 ♀. — **St. 50.** 7-2-1909. 1600 m.w., 5^{30} am., 60 min. 1 ♀. — **St. 52.** 18-2-1909. 300 m.w., 7^{25} am., 30 min. 2 ♀. — **St. 59.** 21-2-1909. 500 m.w., 1^{40} am., 30 min. 1 ♀. — **St. 59.** ibid. 1200 m.w., 2^{30} am., 60 min. 4 ♀. — **St. 61.** 21-2-1909. 600 m.w., 3^{25} pm., 60 min. 1 ♀. — **St. 98.** 23-6-1910. 65 m.w., 6^{35} pm., 15 min. 3 ♀ (1 with ova 10 mm). — **St. 99.** 24-6-1910. 65 m.w., 0^{10} am., 15 min. 1 ♀. — **St. 99.** ibid. 300 m.w., 11^{25} pm., 30 min. 2 ♀. — **St. 106.** 25-6-1910. 1200 m.w., 0^{20} am., 60 min. 4 ♀. — **St. 107.** 25-6-1910. 2000 m.w., 7^{30} am., 60 min. 1 ♀. — **St. 108.** 25-6-1910. 300 m.w., 10^{30} pm., 30 min. 1 ♀. — **St. 108.** ibid. 2000 m.w., 0^{40} am., 60 min. 6 ♀. — **St. 112.** 27-6-1910. 300 m.w., 0^{15} am., 30 min. 3 ♀. — **St. 115.** 28-6-1910. 300 m.w., 11^{20} pm., 30 min. 3 ♀. — **St. 115.** ibid. 2000 m.w., 0^{30} am., 60 min. 2 ♀. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 1 ♀. — **St. 116.** ibid. 300 m.w., 4^{05} pm., 30 min. 3 ♀. — **St. 118.** 30-6-1910. 300 m.w., 5^{55} pm., 30 min. 6 ♀. — **St. 118.** ibid. 300 m.w., 10^{55} pm., 30 min. 3 ♀ (1 with ova 10 mm). — **St. 133.** 14-7-1910. 25 m.w., 11^{00} pm., 30 min. 2 ♀ (1 with ova 10 mm). — **St. 133.** ibid. 300 m.w., 10^{15} pm., 30 min. 2 ♀ (1 with ova 10 mm). — **St. 133.** ibid. 600 m.w., 9^{20} pm., 30 min. 2 ♀. — **St. 138.** 19-7-1910. 300 m.w., 9^{10} pm., 30 min. 1 ♀. — **St. 138.** ibid. 1000 m.w., 7^{40} pm., 60 min. 1 ♀ with ova 10 mm. — **St. 204.** 27-8-1910. 25 m.w., 4^{00} am., 15 min. 2 ♀. — **St. 204.** ibid. 65 m.w., 4^{30} am., 15 min. 2 ♀. — **St. 204.** ibid. 300 m.w., 5^{00} am., 30 min. 5 ♀ (1 with ova 11 mm). — **St. 204.** ibid. 1000 m.w., 5^{55} am., 30 min. 1 ♀. — **St. 205.** 27-8-1910. 25 m.w., 7^{35} pm., 15 min. 15 ♀. — **St. 206.** 28-8-1910. 300 m.w., 1^{05} am., 15 min. 4 ♀ (1 with ova 10 mm). — **St. 206.** ibid. 1000 m.w., 1^{45} am., 45 min. 3 ♀. — **St. 218.** 2-9-1910. 300 m.w., 2^{45} am., 30 min. 4 ♀ (1 with ova 9 mm). — **St. 222.** 4-9-1910. 300 m.w., 11^{20} pm., 30 min. 3 ♀. — **St. 224.** 5-9-1910. 300 m.w., 7^{20} pm., 15 min. 2 ♀.

Atlantic.

St. 91. 18-6-1910. 300 m.w., 6^{55} pm., 45 min. 1 ♀.

The determination of the material given above has caused some difficulty. The species (there are only females) does not quite agree with any of those hitherto described, but is very closely allied to *P. curvipes* Voss., and the difference seems to me so slight as not to be sufficient for the establishing of a new species. Vosseler's description of the said species is based upon an ovigerous ♀ of 17 mm, whereas the largest specimens from the "Thor" only measure 11 mm. This difference in size is in itself sufficient to explain the deviations, of which the most striking is that the femur in p. 5 is not so strongly curved in the "Thor" specimen (Vosseler mentions having found the same characters in the smaller specimens of 11,5—5 mm as in large ones, only less pronounced, and this agrees very well with the "Thor" specimens; but he does not say wherein the deviations consist).

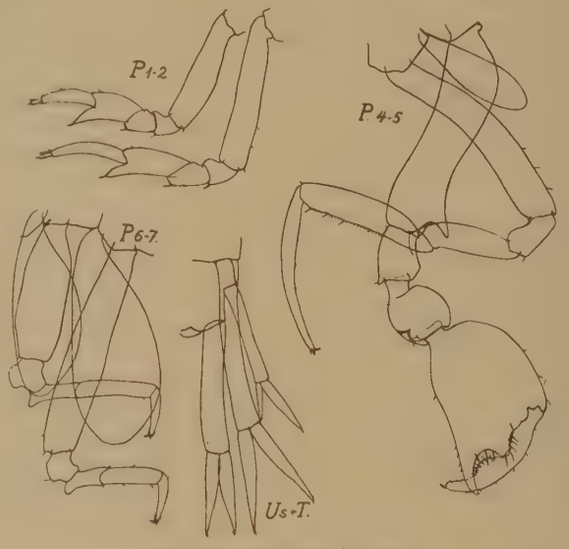

Fig. 52. *Phronima curvipes.*

The subjoined figures and the remarks below are based on a ♀ with ova, 11 mm, from St. 204; point by point it has been compared with the figures and descriptions of Vosseler, but only the deviations are mentioned.

The posterior lateral corners of 1.—3. metasome segments are produced not quite as much as shown by Vosseler. The carpus of p. 1—p. 2 of the same length, not shorter than the metacarpus. P. 3—p. 4 a little longer, not somewhat shorter than p. 5, which is due to the fact that the femur (of p. 3—p. 4) is a good deal longer than shown by V. P. 5 deviates in having the femur a little longer, but not quite so strongly curved; the femur has exactly the same shape in all the specimens at hand, irrespective of size, also in the ovigerous females. The carpus deviates in having the greatest width nearly at the distal, not at the proximal third. P. 6—p. 7 agree very well in shape and relative length with Vosseler's fig. but differ from it in the following points: the femur of p. 6 somewhat broader in the ovigerous specimens than in the younger ones, terminating like the femur of p. 7 in a little spine.

The femur of p. 7 of the same length as the femur of p. 3—p. 5; the branchia on p. 7 of the same length, but not longer than the femur.

The uropoda show the following deviations: In up. 2 the inner ramus is half as long as the outer ramus, not less than half as long. In up. 3 the outer ramus is of the same length, not shorter than the inner ramus.

The material contains 100 spec. (only females) from 24 stations, 37 hauls; all the specimens are from the Mediterranean, except one single specimen from the Atlantic just outside Gibraltar. From the literature, we know only 7 specimens (all females), but I have found 2 spec. in the Copenhagen Zool. Mus.

Chart 17. *Phronima curvipes*, positive stations.

Mediterranean.

	No. of stat.	No. of hauls	No. of spec.
Feb. 1909	6	7	11
June 1910	9	14	38
July —	2	5	9
Aug. —	3	7	32
Sept. —	3	3	9
total...	23	36	99

As a rule, only a few specimens were taken at a time, at most 5; on one occasion, however, 15 spec. (St. 205).

Depths of the sea and occurrence. The species has only been found at depths answering to 500—3000 m. w. It keeps exclusively to the southern part of the western basin, Alboran and Balearic Sea.

Depths of the sea	No. of stations
0— 500	—
> 500—1000	6
> 1000—2000	7
> 2000—3000	10
> 3000	—
total...	23

Vertical occurrence. During the night it was taken in 4 hauls with 25 m. w., but nearly half the hauls have a length of line of 300 m and many hauls a still greater length of line. It thus lives deeper down than most of the other Hyperiidea. During the day it has not been taken nearer the surface than with 300 m. w.

m. w.	No. of hauls	
	Night	Day
25	4	—
65	3	—
300	14	3
> 300	10	2
total	31	5

Size and propagation. (Males are not known at all.) The largest females are 10—11 mm and this also holds good of the few ♀ with ova (7 in all); these have only been found during the period 23. June—2. Sept. Vosseler's type-specimen was an ovigerous ♀ of 17 mm. One specimen in the Copenhagen Zool. Museum measures 15 mm.

Distribution.

1. Mediterranean, see above.

2. Atlantic. "Thor" St. 91. — The German Plankton-Exped. (Vosseler 1901) had 6 spec. from 6 stations, 0—400 m: N. Equatorial Current 1 st. 18.9° N, 26.4° W; S. Equatorial Current 5 st.: 0.1° N, 15.2° W to 7.5° S, 20.3° W, and 5.3° S, 27.6° W. — In our Museum I have found 2 ♀, 11—15 mm from 24°—25° N, 31°—33° W, Iversen ded. 1871, along with 2 *Ph. atlantica*.

3. Indian Ocean. 4 miles NW of Entrance into Desroches Atoll (Amirante), 1 ♀ (Walker 1909)

4. PHRONIMA COLLETTI Bovall. (Chart 18).

Phronima Colletti, Bovallius 1889, p 378, Pl. 16 figs. 27—47. — **P. C.* Vosseler 1901, p. 32 (lit.), Pl. 3 figs. 8—10, Pl. 4 figs. 1—3. — *P. C.* Chun 1895, p. 109, Pl. 8 figs. 1 (cold. fig.)—6. — *P. sedentaria* ♂ Claus, Zeitschr. Wiss. Zool. vol. 22, 1872, p. 334, textfig. 1, Pl. 26—27, figs. 2—12 (not ♀; ♀ = *P. atlantica*).

The peculiar shape of the carpus in p. 5 seems to preclude any confusion with other species.

The Copenhagen Zoological Museum has some specimens determined by Bovallius; they must thus be types or co-types (see Distribution). Some specimens determined as the present species have, however, turned out to belong to quite other species.

Mediterranean.

St. 50. 7-2-1909. 1600 m.w., 5^{30} am., 60 min. 1 ♂ ad. 7 mm. — **St. 98.** 23-6-1910. 65 m.w., 6^{35} pm., 15 min. 4 ♀: 5, 5, 7, 7 mm. — **St. 99.** 23-6-1910. 300 m.w., 11^{25} pm., 30 min. 1 ♀ 7 mm. — **St. 108.** 25-6-1910. 25 m.w., 11^{55} pm., 15 min. 1 ♂ jun. 4 mm. — **St. 112.** 27-6-1910. 25 m.w., 1^{30} am., 15 min. 1 ♀ 7 mm. — **St. 112.** ibid. 300 m.w., 0^{15} am., 30 min. 3 ♂ ad. 7 mm. — **St. 115.** 29-6-1910. 65 m.w., 1^{20} am., 15 min. 1 ♀ 7 mm. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 1 ♂ ad. 6 mm. — **St. 116.** ibid. 65 m.w., 2^{20} am., 30 min. 1 ♂ jun. 4 mm. — **St. 118.** 1-7-1910. 25 m.w., 0^{20} am., 15 min. 2 ♂ ad. 6 mm. — **St. 118.** ibid. 300 m.w., 5^{55} pm., 30 min. 1 ♂ ad. 6 mm. — **St. 121.** 2-7-1910. 25 m.w., 3^{35} am., 30 min. 1 ♂ ad. 7 mm. — **St. 133.** 14-7-1910. 300 m.w., 10^{15} pm., 30 min. 1 ♂ ad. 7 mm. — **St. 134.** 15-7-1910. 300 m.w., 5^{40} am., 30 min. 2 ♂ ad. 7 mm, 1 ♂ jun. 7 mm. — **St. 137.** 19-7-1910. 250 m.w., 9^{05} am., 30 min. 1 ♂ ad. 7 mm. — **St. 204.** 27-8-1910. 1000 m.w., 5^{55} am., 30 min. 1 ♂ ad. 6 mm. — **St. 205.** 27-8-1910. 25 m.w., 7^{35} pm., 15 min. 7 spec.: 4 ♂ ad. 6 mm, 3 ♀ 6—7 mm. — **St. 206.** 28-8-1910. 300 m.w., 1^{05} am., 15 min. 1 ♂ ad. 7 mm.

Atlantic.

St. 63. 22-2-1909. 25 m.w., 0^{05} am., 30 min. 1 ♀ 7 mm. — **St. 65.** 24-2-1909. 25 m.w., 5^{50} am., 30 min. 6 ♀ 7—8 mm. — **St. 65.** ibid. 65 m.w., 6^{30} am., 60 min. 5 spec. 8 mm: 1 ♂ jun., 4 ♀. — **St. 65.** ibid. 300 m.w., 7^{45} am., 120 min. 5 spec.: 1 ♂ ad. 7 mm, 4 ♀ 8 mm. — **St. 65.** ibid. 600 m.w., 10^{00} am., 120 min. 10 spec.: 1 ♂ ad. 7 mm, 9 ♀ 7—9 mm. — **St. 65.** ibid. 1600 m.w. 0^{30} pm., 120 min. 1 ♀ 6 mm. — **St. 66.** 25-2-1909. 1200 m.w., 8^{30} am., 120 min. 2 spec. 7 mm: 1 ♂ ad., 1 ♀. — **St. 69.** 1-3-1909. 25 m.w., 0^{30} am., 30 min. 12 spec.: 1 ♂ ad. 7 mm, 11 ♀ (4 with embryos, 1 with ova) 8—9 mm. — **St. 69.** ibid. 65 m.w., 10^{45} pm., 30 min. 32 spec.: 1 ♂ ad. 8 mm, 2 ♂ jun. 6—7 mm, 26 ♀ (3 with ova, 2 with embr.) 7—8 mm, 3 ♀ 5—6 mm. — **St. 69.** ibid. 300 m.w., 3^{05} pm., 30 min. 9 spec.: 2 ♂ ad. 8—9 mm, 2 ♂ jun. 5 mm, 5 ♀ (1 with ova) 7 mm. — **St. 69.** ibid. 300 m.w., 11^{40} pm., 30 min. 34 spec.: 7 ♂ ad. 7 mm, 3 ♂ jun. 5—6 mm, 24 ♀ (2 with ova) 6—8 mm. — **St. 69.** ibid. 600 m.w., 9^{00} pm., 60 min. 25 spec.: 1 ♂ ad. 8 mm, 8 ♀ with ova 7 mm, 16 ♀ without ova 5—7 mm. — **St. 69.** ibid. 3000 m.w., 6^{30} pm., 60 min. 3 spec.: 1 ♂ ad. 7 mm, 2 ♀ 7—8 mm. — **St. 87.** 17-6-1910. 300 m.w., 4^{00} pm., 30 min. 1 ♀ with embryos 7 mm. — **St. 89.** 18-6-1910. Surf. (P. 100), 3^{30} am., 10 min. 1 ♂ ad. 7 mm. — **St. 89.** ibid. 300 m.w., 3^{25} am., 30 min. 1 ♂ ad. 7 mm. — **St. 91.** 18-6-1910. 300 m.w., 6^{55} pm., 45 min. 30 spec.: 4 ♂ ad. 7 mm, 2 ♂ jun. 6 mm, 4 ♀ with ova 8 mm, 20 ♀ without ova 7—8 mm. — **St. 91.** ibid. 1600 m.w., 5^{25} pm., 60 min. 1 ♀ with ova 8 mm. — **St. 92.** 19-6-1910. 65 m.w., 3^{40} am., 30 min. 2 ♀ 8 mm. — **St. 95.** 23-6-1910. 25 m.w., 6^{35} am., 15 min. 2 ♀ 8 mm. — **St. 95.** ibid. 65 m.w., 5^{50} am., 30 min. 2 ♀ 8 mm. — **St. 232.** 9-9-1910. 25 m.w., 8^{50} pm., 30 min. 34 spec.: 2 ♂ ad. 7 mm, 6 ♂ jun. 6—8 mm, 26 ♀ 6—8 mm. — **St. 233.** 10-9-1910. 25 m.w., 5^{05} am., 15 min. 8 spec.: 1 ♂ ad. 7 mm, 7 ♀ 6—8 mm. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 8^{15} pm., 30 min.: abt. 435 spec.: 35 ♂ ad. 7 mm, 75 ♂ jun. 6—7 mm, abt. 325 ♀ 5—7 mm (10 with ova 7 mm). — **St. 376.** ibid. 30 m.w., 8^{10} pm., 30 min. 51 spec.: 7 ♂ ad. 7—8 mm, 10 ♂ jun. 6—7 mm, 34 ♀ (5 with ova, 1 with embr. 8 mm). 5—7(8) mm. — **St. 377.** 31°23′ N, 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 8^{05} pm., 30 min. abt. 500 spec.: 40 ♂ ad. 7—8 mm, 85 ♂ jun. 6—7 mm, abt. 375 ♀ (8 with ova, 2 with) embryos 8 mm) 6—8 mm. — **St. 382.** 34°21′ N, 16°24′ W. 23-10-1911. 22 m.w. (S. 100), 6^{05} pm., 30 min. 76 spec.: 27 ♂ ad. 7—8 mm, 8 ♂ jun. 6—7 mm, 41 ♀ (6)7—8 mm. — **St. 383.** 37°16′ N, 14°09′ W. 23-10-1911. 30 m.w. (S. 100), 6^{30} pm., 30 min. 163 spec.: 74 ♂ ad. 7-8 mm, 29 ♂ jun. 6—7 mm, 60 ♀ (5)6—7(8) mm. — **St. 386.** 36°30′ N, 7°30′ W. 15-11-1911. 122 m.w. (S. 150), 5^{30} am., 30 min. 1 ♀ 7 mm. — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. Surf. (S. 200), 1^{10} am. 30 min. 43 spec.: 1 ♂ ad. 7 mm, 3 ♂ jun. 5 mm, 39 ♀ 4—6 mm. — **St. 398.** ibid. 56 m.w. (S. 150), 12^{40} am., 30 min. 26 spec.: 7 ♂ ad. 7—8 mm, 3 ♂ jun. 6 mm, 16 ♀ (1 with embryos) 7—8 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. abt. 450 spec.: 3 ♂ ad. 7 mm, 50 ♂ jun. 5—6 mm; abt. 400 ♀ 4—6 mm. — **St. 399.** ibid. 56 m.w. (S. 150), 9^{10} pm., 30 min. 41 spec.: 7 ♂ ad. 7 mm, 8 ♂ jun. 4—6 mm, 26 ♀ (1 with ova 8 mm) (4)5—7 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 10^{15} pm., 30 min. 6 spec.: 2 ♂ ad. 8 mm, 1 ♂ jun. 7 mm, 3 ♀ 6—8 mm. — **St. 400.** ibid. 56 m.w. (S. 150), 9^{35} pm., 30 min. 8 spec.: 3 ♂ ad. 8 mm, 1 ♂ jun. 7 mm, 4 ♀ (1 with ova) 8 mm.

The "Thor" material contains > 2000 spec. (541 ♂, > 1500 ♀), from 34 stat., 53 hauls; the greater part of the yield originates from the Atlantic.

A. Mediterranean.

	No. of stat.	No. of hauls	No. of specimens ♂	No. of specimens ♀
Feb. 1909	1	1	1	—
June 1910	6	8	6	7
July —	5	6	9	—
Aug. —	3	3	7	3
total...	15	18	23	10

Depths of the sea and occurrence. Of the 15 stations in all there are only two with a depth < 500 m *viz.* 175—195 and 400 m; the greater part (9 in all) have a depth of 2000—3000 m. The species is only to be found in the western basin, but is entirely lacking in the Tyrrhenian Sea. The only mention in literature as to occurrence in the Mediterranean is Algiers, without further data (Chevreux, 1900).

Depths in m	No. of stations
0— 500	2
> 500—1000	3
> 1000—2000	1
> 2000—3000	9
> 3000	—
total...	15

Vertical occurrence. At night it has hardly been taken except with 25—300 m. w.; only two hauls have a greater length of wire (1000—1600 m. w.). During the day there are two hauls with 250—300 m. w.

m. w.	No. of hauls	
	Night	Day
25	6	—
65	3	—
250	—	1
300	5	1
> 300	2	—
total...	16	2

Size and propagation. Both sexes seem to attain the same size, 7 mm. The most peculiar thing is that there are more males (23) than females (10) whereas in the case of *Phronima* the proportion is otherwise, usually the reverse. No females with ova or young have been found.

B. Atlantic.

There are 35 hauls from 19 stations, about 2000 spec. (518 ♂, about 1500 ♀). As contrasted with the Mediterranean, where only a single or very few specimens have been taken, at most 7 per haul, the hauls in the Atlantic have in many cases given many specimens, 25—50 spec. per haul; in a few cases even 163, 435 or 500 spec.

	No. of stat.	No. of hauls	No. of specimens		
			♂	♀	total
"Thor" Feb. 1909....	3	7	4	26	30
March —	1	6	20	95	115
June 1910....	5	8	8	32	40
July —	2	2	9	33	42
total ...	11	23	41	186	227
other vessels.....	8	12	477	>1300	abt.1800
total ...	19	35	518	abt.1500	abt.2000

Depths of the sea and occurence. The depth of the sea is nearly as in the Mediterranean; most often 1000—3000 m; 2 stations are less than 500 m (275 and 490 m), 2 stations > 4000 m.

All the stations of the "Thor" itself lie in the Bay of Cadiz, the rest to the south-west of the latter. The species has previously only been caught at the limit of the "Thor" area: 38°06′ N, 29°18′ W. (Chevreux 1900) and Canaries (Chun l. c.).

Vertical occurrence. Nearly all the night hauls were made quite close to the surface; 10—65 m. w. During the day, on the other hand, it has been taken with 300 m.w. or more; but there are two hauls with 25—65 m. w. There does not seem to be any difference between the two sexes as regards depth.

m. w.	No. of hauls	
	Night	Day
10 -35	14	1
56—65	6	1
122	1	—
300	3	3
> 400	2	4
total...	26	9

Size and propagation. The size is, for both sexes, 7—8 mm, ♀, however, at times 9 mm. Vosseler gives for ♂ ad. 7—7.5 mm, for ♀ 7.5—8 mm; Chun gives 11 mm and Bovallius even 12—18 mm which figure must doubtless be taken with due reservation. As contrasted with the Mediterranean there are about 3 times as many females as males.

There are altogether 43 ♀ with ova caught on the following dates: 1. March (14 spec. 4 hauls), 18. June (5 spec. 2 hauls), 22.—23. July (23 spec. 3 hauls) and 26.—30. Oct. (2 spec. 2 hauls). The length of wire is at night 15—600 m, during the day 300—1600 m. There are 7 females with embryos, caught on nearly the same dates, with 15—65 m.w. at night and 300 m. w. during the day.

As to the colour see Chun 1889, p. 528, Pl. 3 fig. 5 = Chun 1895 fig. 1 (cold. fig.).

Symbiosis: The "Thor" collections give no information as to this, but Vosseler has found 2 females in *Diphyes*, and Chun (1889) records it from *Abyla*.

Distribution.

1. Mediterranean, see above.

2. Atlantic. "Thor" see above. — 3 stations

Chart 18. *Phronima Colletti*, positive stations. (St. 376 and following stations [except st. 386] lie outside the map to the S.W.)

41°39½′ N, 41°41½′ W, to 40°28¾′ N, 38°53′ W, and 38°06′ N, 29°18′ W; surf., night, 5 ♂, 16 ♀ (Chevreux, 1900). — From Bay of Biscay to Canaries, Dec., 0—450 m (Chun, 1895, p. 109, *Ph. Diogenes*). — Canaries, "vereinzelt in allen Tiefennetzen von 350—1500 m" (Chun 1889, *Ph. Diogenes*). — 4° N, 6° W, Prosch ded. 1847, Bovallius det., 1 ♂ jun. (Zool. Museum).

The German Plankton-Exped. (Vosseler 1901) had 40 spec. (15 ♂, 25 ♀) from 23 stations. Florida Current 2 st.: 40.4° N, 57° W, 0—200 m, and 37.9° N, 59.1° W, surf. N Equatorial Current 10 st.: 3 st. 25.1° N, 31.5° W to 24.6° N, 31° W, 0—400 (0—100) m; 5 st. 20.7° N, 28.1° W to 13.3° N, 22.7° W, 0—400 (0—200) m; 2 st. 10.2° N, 22.2° W. Guinea Current 7.9° N, 21.4° W, 0—200 m and 9.4° N, 41.9° W, 0—400 m. S Equatorial Current 7 st. from 1,7° N, 17.3° W to 7.8° S, 17.3° W; besides 3.8° S, 32.6° W and 3.6° S, 33.2° W; 0—400 (600) m or surf.

3. Indian Ocean. Bay of Bengal (Giles 1888, *Ph. bucephala*). - 22°44′ S, 86° E, Andrea ded. 1869, 1 ♀ (Bovallius det.; Zool. Museum).

4. Pacific. 4°—21° N, 127°—151° W (Streets 1877—1878; *P. pacifica* jun.) — Chile (Claus 1872, *Ph. sedentaria* ♂). — 40° N—30°41′ S, 97°14′ W—157°37′ W (Streets 1882—83, *P. pacifica* jun.). The two areas given by Streets 1877—78 and 1882—83 are perhaps too large, as *P. pacifica* Streets comprises both the real *P. pacifica* and *P. Colletti* (by Streets called *P. pacifica* jun.).

5. PHRONIMA PACIFICA Streets (non Stebb).

Phronima pacifica ad. (non jun.; jun. = *P. Colletti*) Streets Bull. U. S. Nat. Mus. No. 7 (= Smithson. Miscell. Coll. vol. 13) 1877—78, p. 128. — *P. p.* ad. (non jun.) Streets, Proc. U. S. Nat. Mus. vol. 5, 1882—83, p. 6, Pl. 1 figs. 3, 3 a. — **P. p.* Vosseler, 1901 p. 29, Pl. 3 figs. 4—7. — non *P. p.* Stebbing 1888 and Bovallius 1889 (= *P. Stebbingi* Vosseler 1901).

Atlantic.

St. 69. > 3500 m. 36°13′ N, 9°48′ W. 28-2-1909. 300 m.w., 11^{40} pm., 30 min. 1 ♀ with great marsupial plates 11 mm. — **St. 400.** > 4500 m. 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 10^{15} pm., 30 min. 3 ♀ 7—10 mm.

The present specimens agree very well with the descriptions given by Streets and Vosseler. The species is new to these regions of the Atlantic.

Only the ♀ is described. (♂ jun. and ♀ jun. described by Stebbing are *P. Colletti*; a ♂ jun. (Vosseler 1901) may perhaps be referred to this species; Walker 1909 mentions a ♂, 7 mm, without description).

As to the time of propagation no data are at hand beyond Vosseler's mention (l. c.) of 2 ♀ with ova and young taken 7.—9. Sept. (5.1° S, 14.1° W, and 0.3° S, 15° W).

Distribution.

1. Mediterranean. This species was not taken by the "Thor" Exped.; but Vosseler (in Lo Bianco 1903—04, p. 278) enumerates 9 spec. (♂, ♀) from 4 stations, daytime, 0—2000 m. w., Feb. 6 to April 3, from Naples.

2. Atlantic. "Thor" see above. — The German Plankton Exped. (Vosseler 1901) enumerates 22 spec. (3 ♂ jun., 3 ♀ ad., 16 ♀ jun.) from 13 stations: Florida Current 41.6° N, 53.3°′ W, surf.; Northern Equat. Current and Canarian C. 20.7° N, 28.1° W, 0—200 m, and 10.2° N, 22.2° W, 0—400 m; Guinea Current 7.9° N, 21.4° W, 0—200 m, and 53.° N, 19.9° W, 0—400 m; S. Equat. Current 5 st. 0.1° N, 15.2° W to 5.1° S, 14.1° W, and 3 st. 3.8° S, 32.6° W to 4.4° S, 29.2° W, 0 to 0—600 m.

3. Indian Ocean. 10°27′ S, 51°17′ E, 1000 fms., 1 spec., and 3 miles NE of Desroches Atoll (Amirante), 250—300 fms., 1 jun., 1 ♂ 7 mm (Walker 1909, p. 51).

4. Pacific. China Sea 1 ♀ (Vosseler l. c.). — 4°—21° N, 127°—151° W (Streets 1877—78) and 40° N—30°42′ S, 97°14′ W—157°37′ W (Streets 1882—83). (The areas given by Streets are perhaps somewhat too great, as *P. pacifica* jun. Streets is not this species, but *P. Colletti*).

2. Genus Phronimella Claus.

Phronimella Bovallius 1889, p. 386 (lit.). — *P.* Vosseler 1901, p. 39.

1. PHRONIMELLA ELONGATA Claus (Chart 19).

Phronimella elongata Stebbing 1888, p. 1362. — **P. e.* Bovallius 1889, p. 389 (lit. and syn.), Pl. 16 fig. 51—67. — *P. e.* Vosseler 1901, p. 40, textfig. — *P. e.* Pesta 1920, p. 30, fig.

Mediterranean.

St. 12. 19-12-1908. 300 m.w., 11^{40} am., 60 min. 1 ♂ jun. 8 mm. — **St. 15.** 22-12-1908. 1400 m.w. (5^{20} am.?) 60 min. 1 ♀ 12 mm. — **St. 23.** 15-1-1909. 25 m.w., 11^{50} pm., 30 min. 1 ♀ 12 mm. — **St. 25.** 17-1-1909. 65 m.w., 4^{40} pm., 30 min. 2 ♀ 10—15 mm. — **St. 25.** 17-1-1909. 65 m.w., 4^{40} pm., 30 min. 2 ♀ 10—15 mm. — **St. 26.** 19-1-1909. 150 m.w., 0^{50} am., 180 min. 5 spec.: 1 ♂ ad. 8 mm, 2 ♂ jun. 8 mm, 2 ♀ 10 mm. — **St. 40.** 1-2-1909. 65 m.w., 9^{30} pm., 30 min. 1 ♀ 8 mm. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 6 spec.: 2 ♂ jun. 6—10 mm, 3 ♀ 10—13 mm, 1 ♀ 15 mm. — **St. 118.** 1-7-1910. 25 m.w., 0^{20} am., 15 min. 1 ♀ 13 mm. — **St. 123.** 3-7-1910. 10 m.w., 2^{30} am., 15 min. 3 ♀ 10—14 mm. — **St. 123.** ibid.

25 m.w., 1^{50} am., 15 min. 25 spec.: 3 ♂ jun. 5 mm, 2 ♂ jun. 8 mm, 6 ♀ abt. 15 mm, 3 ♀ abt. 11 mm, 11 ♀ 5—10 mm. — **St. 123.** ibid. 65 m.w., 0^{55} am., 30 min. 2 ♀ 14—16 mm. — **St. 124.** 3-7-1910. 65 m.w., 3^{30} am., 90 min. 1 ♀ 14 mm. — **St. 129.** 12-7-1910. 25 m.w., 3^{00} am., 30 min. 41 spec.: 6 ♂ ad. 9 mm, 13 ♂ jun. 4—8 mm, 22 ♀ 6—16 mm. — **St. 129.** ibid. 300 m.w., 3^{40} am., 30 min. 38 spec.: 5 ♂ ad. 8 mm, 5 ♂ jun. 5—8 mm, 4 ♀ 15—16 mm, 19 ♀ 10—14 mm, 5 ♀ 5—9 mm. — **St. 129.** ibid. 600 m.w., 8^{00} pm., 30 min. 22 spec.: 1 ♂ ad. 8 mm, 4 ♂ jun. 8 mm, 9 ♀ 12—16 mm, 2 ♀ 10 mm, 4 ♀ 7—8mm, 2 ♀ 5 mm. — **St. 129.** ibid. 1000 m.w., 4^{20} am., 60 min. 9 spec.: 1 ♂ ad. 8 mm, 5 ♀ 12—14 mm, 1 ♀ 11 mm, 2 ♀ 7—9 mm. — **St. 129.** ibid. 3500 m.w., 3^{00} pm., 120 min. 19 spec.: 4 ♂ jun. 8 mm, 7 ♀ 14—18 mm, 4 ♀ 11—13 mm, 4 ♀ 7—9 mm. — **St. 130.** 13-7-1910. 25 m.w., 0^{50} am., 30 min. 8 spec.: 7 ♀ 11—14 mm, 1 ♀ abt. 7 mm. — **St. 131.** 13-7-1910. 300 m.w., 10^{35} am., 30 min. 3 spec.: 1 ♂ jun. 7 mm, 2 ♀ 9—14 mm. — **St. 132.** 14-7-1910. 25 m.w., 3^{05} am., 30 min. 14 spec.: 6 ♂ ad. 9 mm, 1 ♂ ad. 7 mm, 1 ♂ jun. 8 mm, 5 ♀ 8 mm, 1 ♀ 13 mm. — **St. 132.** ibid. 300 m.w., 3^{45} am., 30 min. 6 spec.: 1 ♂ ad. 9 mm, 1 ♀ 18 mm, 4 ♀ 12—14 mm. — **St. 132.** ibid. 600 m.w., 4^{50} am., 30 min. 2 spec.: 1 ♂ ad. 9 mm, 1 ♀ 13 mm. — **St. 133.** 14-7-1910. 25 m.w., 11^{00} pm., 30 min. 3 spec.: 1 ♂ jun. 8 mm, 2 ♀ 12—13 mm. — **St. 133.** ibid. 300 m.w., 10^{15} pm., 30 min. 1 ♀ 12 mm. — **St. 133.** ibid. 600 m.w., 9^{20} pm., 30 min. 1 ♀ abt. 14 mm. — **St. 137.** 19-7-1910. 25 m.w., 8^{15} am., 30 min. 1 ♂ jun. 8 mm. — **St. 138.** 19-7-1910. 25 m.w., 9^{50} pm., 30 min. 51 spec.: 4 ♂ ad. 8—9 mm, 2 ♂ jun. 7 mm, 10 ♂ jun. 5—6 mm, 1 ♀ 19 mm, 2 ♀ 17 mm, 2 ♀ 16 mm, 1 ♀ 15 mm, 2 ♀ 14 mm, 3 ♀ 13 mm, 11 ♀ 10—11 mm, 13 ♀ 4—9 mm. — **St 138** ibid. 300 m.w., 9^{10} pm., 30 min. 1 ♀ 10 mm. — **St 138.** ibid. 1000 m.w., 7^{40} pm., 60 min. 1 ♀ 15 mm. — **St. 143.** 23-7-1910. 25 m.w., 1^{20} am., 30 min. 10 spec.: 1 ♂ ad. 9 mm, 1 ♂ jun. 8 mm, 1 ♀ 16 mm, 1 ♀ 15 mm, 3 ♀ 14 mm, 3 ♀ 11—13 mm. — **St. 144.** 24-7-1910. 25 m.w., 2^{00} am., 30 min. 5 spec.: 1 ♂ jun. 6 mm, 1 ♀ 11 mm, 3 ♀ 7—9 mm. — **St. 144.** ibid. 300 m.w., 2^{45} am., 30 min. 1 ♀ 12 mm. — **St 145.** 25-7-1910. 25 m.w., 3^{30} am., 30 min. 6 spec.: 1 ♂ ad. 9 mm, 4 ♀ 12—15 mm, 1 ♀ 10 mm. — **St. 145.** ibid. 300 m.w., 4^{10} am., 30 min. 1 ♀ 12 mm. — **St. 147.** 25-7-1910. 25 m.w., 11^{35} pm., 30 min. 32 spec.: 6 ♂ ad. 8—9 mm, 4 ♂ jun. 5—8 mm, 18 ♀ 12—16 mm, 4 ♀ abt. 8 mm. — **St. 147.** ibid. 300 m.w., 0^{20} am., 30 min. 2 ♀ 13—17 mm. — **St. 147.** ibid. 1000 m.w., 1^{10} am., 60 min. 3 spec.: 1 ♂ ad. 9 mm, 2 ♀ 10 mm. — **St. 152.** 27-7-1910. 25 m.w., 10^{50} pm., 15 min. 11 spec.: 2 ♂ ad. 8—9 mm, 3 ♂ jun. 7—9 mm, 6 ♀ 10—15 mm. — **St. 156.** 30-7-1910. 25 m.w., 2^{55} am., 30 min., 32 spec.: 6 ♂ ad. 9 mm, 18 ♀ 11—15 mm, 6 ♀ 9—10 mm, 6 ♀ 6 mm. — **St. 156.** ibid. 300 m.w., 3^{50} am., 30 min. 1 ♀ 15 mm, 4 ♀ 8—12 mm. — **St. 156.** ibid. 600 m.w., 3^{00} am., 30 min. 8 spec.: 2 ♂ ad. 9 mm, 1 ♂ jun. 7 mm, 5 ♀ 12—14 mm. — **St. 156.** ibid. 1000 m.w., 0^{40} am., 60 min. 11 spec.: 1 ♂ ad. 8 mm, 2 ♂ jun. 6 mm, 6 ♀ 11—13 mm, 2 ♀ 6—7 mm. — **St. 158.** 31-7-1910. 300 m.w., 7^{30} am., 30 min. 67 spec.: 16 ♂ ad. 8—9 mm, 11 ♂ jun. 7—8 mm, 37 ♀ 11—13 mm, 3 ♀ 7—9 mm. — **St. 160.** 1-8-1910. 25 m.w., 2^{00} am., 30 min. 34 spec.: 2 ♂ ad. 9 mm, 8 ♂ jun. 7—8 mm, 3 ♂ jun. 4—5 mm, 9 ♀ 12—14 mm, 2 ♀ 10 mm, 6 ♀ 7 mm, 4 ♀ 4—5 mm. — **St. 160.** ibid. 300 m.w., 2^{45} am., 30 min. 8 spec.: 2 ♂ ad. 8 mm, 5 ♀ 12—14 mm, 1 ♀ 8 mm. — **St. 160.** ibid. 1000 m.w., 3^{35} am., 60 min. 6 spec.: 1 ♂ ad. 9 mm, 1 ♂ jun. 8 mm, 2 ♀ 14 mm, 2 ♀ 12—13 mm. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 242 spec.: 26 ♂ ad. 8—9 mm, 22 ♂ jun. 6—7 mm, 2 ♂ jun. 5 mm, 66 ♀ 11—15 mm, 86 ♀ 7—10 mm, 40 ♀ 5—6 mm. — **St. 163.** 3-8-1910. 25 m.w., 1^{05} am., 15 min. 5 spec.: 2 ♂ jun. 7—8 mm, 3 ♀ 7 mm. — **St. 163.** ibid. 300 m.w., 1^{05} am., 15 min. 6 spec.: 1 ♂ jun. 7 mm, 4 ♀ 13 mm, 1 ♀ 5 mm. — **St. 163.** ibid. 1000 m.w., 0^{05} am., 30 min. 2 ♀ 12 mm, 1 ♀ 10 mm. — **St. 182.** 13-8-1910. 10 m.w., 11^{00} pm., 15 min. 2 ♀ 12 mm. — **St. 182.** ibid. 65 m.w., 10^{30} am., 15 min. 1 ♀ 12 mm. — **St. 187.** 18-8-1910. 25 m.w., 7^{45} pm., 15 min. 7 spec.: 1 ♂ ad. 9 mm, 1 ♀ 14 mm, 4 ♀ 13 mm, 1 ♀ 6 mm. — **St. 190.** 19-8-1910. 25 m.w., 8^{15} pm., 15 min. 13 spec.: 1 ♂ ad. 9 mm, 4 ♂ jun. 6—8 mm, 1 ♀ 17 mm, 2 ♀ 13 mm, 1 ♀ 11 mm, 4 ♀ 8 mm. — **St. 192.** 20-8-1910. 25 m.w., 9^{40} pm., 15 min. 10 spec.: 1 ♂ ad. 10 mm, 1 ♂ jun. 8 mm, 7 ♀ 15—17 mm, 1 ♀ 10 mm. — **St. 192.** ibid. 300 m.w., 10^{10} pm., 15 min. 1 ♂ jun. 7 mm. — **St. 193.** 21-8-1910. 10 m.w., 0^{50} am., 30 min. 23 spec.: 2 ♂ ad. 10 mm, 2 ♂ ad. 9 mm, 3 ♂ jun. 5—9 mm, 13 ♀ 11—17 mm, 2 ♀ 9 mm, 1 ♀ 5 mm. — **St. 194.** 21-8-1910. 10 m.w., 4^{30} am., 15 min. 4 spec.: 1 ♂ ad. 9 mm, 1 ♂ jun. 8 mm, 2 ♀ 13 mm. — **St. 194.** ibid. 25 m.w., 5^{00} am., 15 min. 29 spec.: 4 ♂ ad. 8 mm, 8 ♂ jun. 6—7 mm, 13 ♀ 11—13 mm, 4 ♀ 7 mm. — **St. 194.** ibid. 1200 m.w., 6^{00} am., 30 min. 2 ♀ 9—13 mm. — **St. 195.** 21-8-1910. 65 m.w., 6^{50} pm., 15 min. 1 ♀ 10 mm. — **St. 196.** 22-8-1910. 25 m.w., 2^{40} am., 30 min. 8 spec.: 1 ♂ jun. 6 mm, 1 ♀ 13 mm, 4 ♀ 10—11 mm, 2 ♀ 6 mm. — **St. 197.** 24-8-1910. 25 m.w., 7^{45} pm., 15 min. 60 spec.: 6 ♂ ad. 9 mm, 4 ♂ jun. 8—9 mm, 7 ♂ jun. 6—7 mm, 27 ♀ 12—14 mm, 4 ♀ 9 mm, 12 ♀ 6—7 mm. — **St. 197.** ibid. 300 m.w., 7^{00} pm., 30 min. 1 ♂ jun. 7 mm. — **St. 199.** 25-8-1910. 25 m.w., 9^{00} pm., 15 min. 23 spec.: 2 ♂ ad. 9 mm, 4 ♂ jun. 5—7 mm, 2 ♀ 16—17 mm, 9 ♀ 10—15 mm, 6 ♀ 6 mm. — **St. 199.** ibid. 1000 m.w., 10^{10} pm., 30 min. 1 ♀ 16 mm, 2 ♀ 8—12 mm. — **St. 200.** 26-8-1910. 25 m.w., 3^{45} am., 30 min. 33 spec.: 5 ♂ ad. 8—9 mm, 8 ♂ jun. 6—8 mm, 1 ♀ 17 mm, 15 ♀ 11—13 mm, 4 ♀ 10 mm. — **St. 202.** 26-8-1910. 300 m.w., 5^{05} pm., 15 min. 2 ♀ 14 mm, 1 ♀ 12 mm. — **St. 204.** 27-8-1910. 25 m.w., 4^{00} am., 15 min. 19 spec.: 1 ♂ jun. 7 mm, 8 ♀ 10—17 mm, 10 ♀ 6—7 mm. — **St. 204.** ibid. 65 m.w., 4^{30} am., 15 min. 23 spec.: 4 ♂ jun. 6—8 mm, 13 ♀ 13—15 mm, 4 ♀ 10—11 mm, 2 ♀ 6 mm. — **St. 204.** ibid. 300 m.w., 5^{00} am., 30 min. 6 spec.: 1 ♂ ad. 9 mm, 5 ♀ 6—15 mm. — **St. 204.** ibid. 1000 m.w., 5^{55} am., 30 min. 1 ♀ 9 mm. — **St. 205.** 27-8-1910. 25 m.w., 7^{35} pm., 15 min. 18 spec.: 2 ♂ ad. 8—9 mm, 1 ♂ jun. 8 mm, 11 ♀ 11—16 mm, 4 ♀ 7—10 mm. — **St. 208.** 29-8-1910. 25 m.w., 1^{40} am., 15 min. 25 spec.: 2 ♂ ad. 8 mm, 2 ♂ jun. 5—7 mm, 21 ♀ 12—16 mm. — **St. 209.** 29-8-1910. 25 m.w., 4^{55} am., 15 min. 30 spec.: 8 ♂ ad. 7—9 mm, 4 ♂ jun. 6—8 mm, 17 ♀ 9—14 mm, 1 ♀ 7 mm. — **St. 209.** ibid. Verticalnet 75—35 m, 4^{10} pm. 1 ♀ 10 mm. — **St. 209.** ibid. 150 m.w., 4^{25} am., 20 min. 6 spec.: 1 ♂ ad. 8 mm, 1 ♂ jun. 8 mm, 3 ♀ 12 mm, 1 ♀ 10 mm. — **St. 209.** ibid. 300 m.w., 5^{25} am., 15 min. 3 ♀ 13 mm. — **St. 209.** ibid. 1000 m.w., 6^{00} am., 45 min. 5 spec.: 2 ♂ ad. 9 mm, 3 ♀ 12 mm. — **St. 210.** 30-8-1910. 25 m.w., 2^{45} am., 30 min. 32 spec.: 4 ♂ ad. 8—10 mm, 7 ♂ jun. 7—8 mm, 20 ♀ 9—16 mm, 1 ♀ 6 mm. — **St. 210.** ibid. 600 m.w., 3^{35} am., 30 min. 1 ♂ jun. 8 mm, 1 ♀ 14 mm. — **St. 275.** 39°5′ N, 14°50′ E. 3-4-1911. 94 m.w. (S. 200), 8^{30} pm., 30 min. 4 spec.: 2 ♂ jun. 7 mm, 2 ♀ 7—14mm. — **St. 276.** 36°36′ N, 19°20′ E. 4-4-1911. 132 m.w. (S. 200), 11^{20} pm., 35 min. 176 spec.: 2 ♂ ad. 10 mm, 46 ♂ jun. 6—9 mm. 44 ♀ 15—16 mm, 24 ♀ 9—14 mm, 60 ♀ 6—8 mm. — **St. 277.**

33°20′ N, 27°30′ E. 6-4-1910. 132 m.w., 11^{00} pm., 35 min. 29 spec.: 4 ♂ jun. 6—9 mm, 13 ♀ 14—16 mm, 4 ♀ 11—13 mm, 8 ♀ 6—10 mm. — **St. 279.** 38°11.5′ N, 15°36.5′ E. 23-2-1911. 30 (S. 100), 7^{00} pm., 150 min. 7 spec.: 1 ♂ ad. 11 mm, 3 ♂ jun. 3 mm, 1 ♀ 12 mm, 2 ♀ 8—10 mm. — **St. 281.** 38°15′ N, 15°37′ E. m.w. 1-3-1911. 30 m.w. (S. 100), 3^{45} pm., 60 min. 4 spec.: 2 ♂ ad. 11 mm, 1 ♂ jun. 10 mm, 1 ♀ 8 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 6^{10} pm., 60 min. 1 ♂ ad. 12 mm, 1 ♀ 15 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 7^{50} pm., 60 min. 5 spec.: 3 ♂ ad. 11 mm, 2 ♂ jun. 8—9 mm. — **St. 282.** 38°12′ N, 15°37′ E. 9-3-1911. 40 m.w. (S. 100), 2^{00} pm., 90 min. 11 spec.: 3 ♂ ad. 9—11 mm, 3 ♂ jun. 9 mm, 3 ♀ 16—18 mm, 2 ♀ 10—11 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 5^{30} pm., 90 min. 4 spec.: 1 ♂ jun. 10 mm, 1 ♀ 16 mm, 2 ♀ 7 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 7^{15} pm., 90 min. 1 ♂ jun. 9 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 9^{00} pm., 90 min. 11 spec.: 1 ♂ jun. 10 mm, 7 ♀ 15—18 mm, 3 ♀ abt. 13 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 10^{45} pm., 180 min. 7 ♀ 6—17 mm. — **St. 283.** 38°12′ N, 15°37′ E. 12-3-1911. 40 m.w. (S. 100), 6^{30} pm., 180 min. 20 spec.: 6 ♂ ad. 11—12 mm; 1 ♂ jun. 10 mm, 5 ♀ 16—17 mm, 6 ♀ 11—12 mm, 2 ♀ 8—9 mm. — **St. 283.** ibid. 40 m. w. (S. 100), 9^{45} pm., 180 min. 8 spec.: 3 ♂ ad. 11 mm, 2 ♂ jun. 9 mm, 1 ♂ jun. 6 mm, 2 ♀ 8—14 mm. — **St. 296.** 32°10′ N, 29°50′ E. 25-6-1911. 28 m.w. (S. 200), 2^{30} am., 30 min. 3 spec.: 1 ♂ ad. 9 mm, 1 ♂ jun. 9 mm, 1 ♀ 13 mm. — **St. 297.** 33°10′ N, 25°35′ E. 25-6-1911. 28 m.w. (S. 200). 11^{30} pm., 30 min. 1930 spec. (50 ccm): 100 ♂ ad. 9—10 mm, 300 ♂ jun. 8—9 mm, 100 ♂ jun. 6—7 mm, 250 ♀ 14—15 mm, 230 ♀ 10—13 mm, 950 ♀ 5—9 mm. — **St. 298.** 34°20′ N, 21°10′ E. 26-6-1911. 38 m.w. (S. 200), 11^{30} pm., 30 min. 1420 spec. (45 ccm): 200 ♂ ad. 9 mm, 120 ♂ jun. 8—9 mm, 20 ♂ jun. 7 mm, 10 ♂ jun. 6 mm, 20 ♀ 18 mm, 150 ♀ 13—16 mm, 800 ♀ 7—12 mm, 100 ♀ 6 mm. — **St. 384.** 32°50′ N, 27°10′ E. 7-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 1 ♂ jun. 8 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 24 spec.: 1 ♂ ad. 9 mm, 8 ♂ jun. 6—8 mm, 7 ♀ 12—15 mm, 8 ♀ 5—7 mm.

Atlantic.

St. 69. 28-2-1909. 65 m.w., 10^{45} pm., 30 min. 4 spec.: 2 ♀ 15—16 mm, 2 ♀ 11—12 mm. — **St. 69.** ibid. 300 m.w., 3^{05} pm., 30 min. 1 ♀ 11 mm. — **St. 264.** 38°14′ N, 24°35′ W. 19-3-1911. 25 m.w. (S. 150), 7^{00} pm., 30 min. 1 ♀ 14—17 mm. — **St. 377.** 31°23′ N, 18°08′ W. 23-7-1911. 15 m.w. (S. 200), 30 min. 9 spec.: 3 ♂ ad. 10 mm, 4 ♂ jun. 6—9 mm. 2 ♀ 6—8 mm. — **St. 382.** 34°21′ N, 16°24′ W. 23-10-1911. 22 m.w. (S. 100), 6^{05} pm., 30 min. 3 ♀ 12—16 mm. — **St. 383.** 37°16′ N, 14°9′ W. 23-10-1911. 30 m.w. (S. 100), 6^{30} pm., 30 min. 3 spec.: 1 ♂ ad. 10 mm, 2 ♀ 13—15 mm. — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. 56 m.w. (S. 150), 12^{40} am., 30 min. 4 spec.: 1 ♂ ad. 10 mm, 3 ♀ 10—13 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min, 3 spec.: 2 ♂ jun. 8 mm, 1 ♀ 12 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. 56 m.w. (S. 150), 9^{35} pm., 30 min. 7 spec.: 1 ♂ jun. 8 mm, 2 ♀ 15—17 mm, 4 ♀ 5—8 mm.

The "Thor" Exp. has in all 4863 spec. (467 ♂ ad., 813 ♂ juv., 3583 ♀) from 64 stations, 109 hauls; nearly all the specimens are from the Mediterranean. The species seems to belong to the most widely distributed and numerous Hyperiidea.

Chart 19. *Phronimella elongata*. ● positive stations, + negative stations (> 500 m, night, 10—300 mw.) Several of the stations lie so close to each other that it was impossible to note them all. Several stations lie outside the Chart the to S.W.

A. Mediterranean.

There are in all 4827 spec. (462 ♂ ad., 806 ♂ jun., 3559 ♀) from 56 stations, 100 hauls.

	No. of st.	No. of hauls	No. of specimens ♂ ad.	♂ jun	♀	total
"Thor" Dec. 1908	2	2	—	1	1	2
Jan. 1909	3	3	1	2	5	8
Feb.	1	1	—	—	1	1
June 1910	1	1	—	2	4	6
July —	17	36	62	70	315	447
Aug. —	20	38	76	103	517	696
"Thor" total	44	81	139	178	843	1160
other vessels Feb.-April 1911	7	14	21	68	200	289
June —	3	3	301	551	2501	3353
Nov. —	2	2	1	9	15	25
other vessels total	12	19	323	628	2716	3667
"Thor" + other vessels total	56	100	462	806	3559	4827

Depths of the sea and occurrence (Chart). The species is oceanic, as the depth being as a rule > 500 m;

t is, however, also to be found at lower levels (175—195 m, 200 m (3 times), 235 m, 350 m, 360 m and 480 m).

The positive stations lie, 29 in the western, 27 in the eastern basin. In the case of the "Thor" alone, the

Dephts of the stations	No. of stations		
	"Thor"	other vessels	total
0— 500 m	5	4	9
> 500—1000 -	13	—	13
> 1000—2000 -	13	1	14
> 2000—3000 -	8	3	11
> 3000 -	5	4	9
total...	44	12	56

figures are 28 and 16 respectively, but of stations with a depth of > 500 m there are only 25 and 14 respectively (Stations 40, 137, 182, 190 and 192 having slighter depths), in all 39 stations. In the western basin it has been found very nearly everywhere, except between Gibraltar and the Balearic Islands; in the eastern, the distribution is more even, apart from the fact that it was not taken within the Adriatic (though STEUER, records it from here 1913, p. 567, 568) and it is absent in the northern half of the Ægean Sea. It is one of the most numerous and most widely distributed Hyperiidea in the Mediterranean.

Considering as negative all stations where it was not taken by the "Thor" in night hauls 10—300 m. w. and at a depth of > 500 m, there are in the western basin 33 negative stations, in the eastern 13, there is however, a good deal of difference according to the time of the year. During the winter there are in the western basin 16 negative stations and only 3 positive ones (St. 23, 25 and 26 [+ St. 40 with a smaller depth of the sea]) in the eastern 6 negative and 2 positive; during the summer there are in the western basin 22 positive stations (+ St. 137 and 193 with smaller depth) and 17 negative, in the eastern 12 positive (+ St. 182 and 190 with a smaller depth) and 7 negative. It may be objected that the figures for the winter are too small to allow of any conclusions; but for the summer, they seem to show, that there are, proportionally a few more positive stations in the eastern than in the western basin.

M. w.	"Thor" 1908—10, > 500 m.				"Thor" and other vessels, > 500 m, night		
	No. of hauls		No. of specimens, night	Average no. of specimens pr. night haul	No. of hauls	Normal hauls (30 min.)	
	Night	Day				No. of specimens	Average no. pr. haul
10— 40	32	—	827	25.8	35	4475	127.9
65 -100		1					
120 -250	36	—	193	5.4	41	402	9.8
300 -400		4					
> 400.....		1					
total...	68	6	1020	—	76	—	—

Vertical occurrence. From the hauls of the "Thor" itself 1908—1910 at stations with a depth > 500 m. 32 or nearly half the night hauls have a length of wire of only 10—35 m. It may be found in large shoals.

The same is shown by collections from other ships or over lower depths of the sea, and this also holds good of STEUER's table from the southern Adriatic (STEUER 1913, p. 567).

Size and propagation. There are about 3 times as many females (3559) as males (1268) (VOSSELER 1901 had 291 ♀, 150 ♂).

The size of ♂ ad. is as a rule 8—10 mm, very rarely 11 mm (13 spec.) or 12 mm (4 spec.). ♂ juv. is at most 10 mm.

♀ is as a rule 16 mm, very rarely 17—19 mm (17 spec. 17 mm; 23 spec. 18 mm; 1 spec. 19 mm). The "Thor" (and VOSSELER 1901) had no females with ova or embryos; but LO BIANCO records (1909, p. 596) from Naples that it has ova in the marsupium in Aug.—Nov. and embryos in Nov.—Jan. The sizes of the specimens have not given any results as to growth and propagation.

B. Atlantic.

There are only 36 spec. from 8 stat., 9 hauls, in the Bay of Cadiz and west or south-west of the latter.

Distribution.

"The subtropical and tropical regions of the Atlantic and of the Pacific; the Mediterranean; the Indian Ocean" (BOVALLIUS 1889).

1. Mediterranean. On the "Thor" etc. see above. — Messina (CLAUS). — At Naples ♂ ad. and ♀ ad. may be found in each haul with 100 m. w., and it is also common deeper down, being the most numerous Phronimid (CHUN, Zoologica 1888, p. 29); but LO BIANCO (1909, p. 596) says that it may be found at Naples during the whole of the year, but not abundant. — VOSSELER (in LO BIANCO 1903—04, p. 278) notes 3 hauls (daytime, 4 spec.) from Naples, 100—2000 m.w.; the hauls with 100 m. w were made with closing-net. — Adriatic: 42°11.3′ N, 17°47′ E, surf., 4 spec. (PESTA 1920, p. 30). — Ragusa (STEUER 1911, p. 673).

2. Atlantic. The northern limit lies at Europe at abt. 36° N, further to the West at abt. 43° N; the southern limit lies at abt. 37° S ("Challenger"). The localities are

the following. "Thor" etc. see above. — Our Zool. Museum has spec. from: 34°20′—34°50′ N, 72°—70°50′ W, Andrea 1862, 9 ♀; 36° N, 43° W, 23-7-1847, "Galatea", 1 ♀; "34°20′ N, 72° W. — 34°50′ N, 10°50′ W", 1862, Andrea, 2 ♀; 34°10′ N, 42°10′ W, 25-8-1863, Andrea, 19 ♀; 32°16′ N, 38°1′ W, Warming 1866, 1 ♀; 31°30′ N, 21°16′ W, 6-4-1882, Hartmann, 1 ♂, 21 ♀; 28° N, 23° 40′ W, 11-4-1882, Hartmann, 4 ♂, 43 ♀; 26°15′ N, 20°56′ W, 7-12-1995, Chr. Levinsen, 1 ♀; 26° N, 26° W, Iversen 1871, 3 ♀; 25° N, 39° W, Hygom 1863, 9 ♀; 24°27′ N, 25°03′ W, surf., "Diana" 1893, Damm, 6 ♀; 23°31′ N, 24°4′ W, Stübe 1860, 2 ♀; 22° N, 22° W, Hygom, 1 ♀; 18°17′ N, 54°14′ W, Hartmann 1882, 1 ♂; 17°46′ N, 51°12′ W, 25 fath., "Diana" 1893, Damm, 1 ♀; 10°22′ N, 21°16′ W, Reinhardt, 1 ♀; 5°31′ N, 23°15′ W, Reinhardt, 2 ♀; 5° N, 32° W, 1860, Hygom, 2 ♂, 2 ♀; 1°20′ S, 28°50′ W, Andrea 1866, 1 ♀; 3° S, 27° W, Hygom, 2 ♀; 29° S, 27°23′ W, 1866, Warming, 1 ♀; without locality, Warming 1863, 4 ♀.

Chevreux (1900) enumerates 65 spec. (33 ♂, 32 ♀) from 7 hauls, surf., night: 38°06′ N, 29°18′ W, and (6 stations) 40½°—42¾° N, 39°—45½° W. — Off Las Palmas (Canaries), 450 m, "an der Oberfläche und in grosser Zahl" (Chun 1889, p. 531).

The German Plankton-Exped. (Vosseler 1901) has 441 spec. (24 ♂ ad., 126 ♂ jun., 105 ♀ ad., 186 ♀ jun.) from 68 hauls: Florida Current 4 st. 41.6° N, 56.3° W, to 37.9° N, 59.1° W, 0—200 or 0—400 m. w. Sargasso Sea 15 st.: 37.1° N, 59.9° W; 34.7° N, 62.4° W to 31.5° N, 40.7° W; 29.8° N, 36.8° W to 25.6° N, 34.9° W; 30.8° N, 30.9° W; 0—400 or 0—200 m. w. N. Equatorial Current 12 st. 28.3° N, 34.3° W to 10.2° N, 22.2° W; 12° N, 40.3° W; 0—400 (0—200) m. w. Guinea Current 7 st. 7.9° N, 21.4° W, to 5.3° N, 19.9° W; 9.4° N, 41.9° W; 0—400 or 0—200 m. w. Gulf Stream 1 st.: 37.7° N, 25.2° W, 0—80 m. w. S. Equatorial Current 29 st.: 1.7° N, 17.3° W, to 0° N, 15.2° W; 0.3° S, 15.0° W, to 6.8° S, 14.2° W; 7.8° S, 17.3° W, to 4.4° S, 29.2° W; 3.9° S, 30.1° W, to 0.4° S, 42.4° W; 0—400 (500) or 0—200 (100) m. w.

The "Challenger" Exp. (Stebbing 1888) has the species from the following localities: 25°45′ N, 20°14′ W, surf., 1 ♀; 3°10′ N, 14°51′ W, 200—0 fms., 2 ♀; 1°47′ N, 24°26′ W, 40—0 fms., 21 ♀, 9 ♂; 1°10′ N, 28°23′ W, surf., 11 ♀; 2°42′ S, 14°41′ W, surf., 1 ♀; 36°1′—36°32′ S, 47°35′—42°47′ W, 1 ♀.

3. Indian Ocean. The Copenhagen Zoological Museum has specimens from: S of Madagascar, Traustedt, 1 ♀; 40°4′ S, 53°20′ E, 1869, Andrea, 7 ♀; 32°40′ S, 55°20′ E, Andrea 1861, 2 ♀; 32°15′ S, 58°30′ E, Andrea 1864, 7 ♀; 27° S, 101°40′ E, 2 ♀. — Bay of Bengal (Giles). — S. of Mindanao, Celebes Sea, 6°20′ N, 123°18′ E, surf., night, 1 ♂, 5 ♀ ("Challenger"). — Walker (1909, p. 51) mentions "numerous specimens throughout the voyage" ("Sealark"-Exped., between Madagascar and Maldive Archipelago) from the surface to 1000 fms.

4. Pacific. 34°00′ N—30°40′ S, 102°43′—150°00′ W, 1 ♂, 6 ♀ (Streets 1877, 1882). — China Sea 2 ♂, 5 ♀ (Vosseler 1901). — Admirality Islands to Japan, 1 ♀; 26°29′ N, 137°57′ E, surf., 1 ♀, 6 ♀; 24°49′ N, 138°34′ E, surf., 1 ♀; 16°35′ N, 117°47′ E, surf., 2 ♀; W. Pacific N of New Guinea, 1 ♂, 2 ♀; 7°35′ N, 149°49′ W, 2 ♂; 7°35′—5°54′ N, 149°49′—147°2′ W, surf., 3 ♀ (Stebbing, "Challenger"). — 27°30′ S, 98°—99° W, Andrea, 3 ♀ (spec. in our Zool. Museum).

Fam. Anchylomeridæ Bovall.

Anchylomeridæ Bovallius 1889, p. 396 (lit. and syn.). — *Phrosinidæ* Stebbing 1888, p. 1423 (lit. and syn.).

The only three species which can be said to be well-known are all to be found in the "Thor" material, both from the Atlantic and from the Mediterranean.

Chun (1887, p. 29) mentions an *Anchylomera* n. sp. from Capri: "In dem Schliesnetze fand sich ein Exemplar aus 600 M. und zwei Exemplare aus 1000 M. Tiefe vor Capri. Sie war auch im Januar häufig in dem offenen Netze aus grösseren Tiefen vorhanden." As far as I know, nothing has been elucidated as to which species these specimens belonged to; but it can hardly be any other than *A. Blossevillei*.

1. Genus Anchylomera Milne-Edwards.

Anchylomera Stebbing 1888, p. 1432 (lit.). — *A.* Bovallius 1889, p. 408.

1. ANCHYLOMERA BLOSSEVILLEI Milne-Edwards (Chart 20).

**Anchylomera Blossevillei* Stebbing 1888, p. 1433, Pl. 177 (lit.). — **A. B.* Bovallius 1889, p. 412, Pl. 17 fig. 1—22 (lit.). — *A. B.* Vosseler 1901, p. 88, textfig.

Mediterranean.

St. 10. 15-12-1908. 1200 m.w., 9^{30} am., 120 min. 1 spec. jun. 3 mm. — **St. 24.** 17-1-1909. 65 m.w., 7^{50} am., 30 min. 5 ♀ 5—8 mm (1 with embr. 8 mm). — **St. 25.** 17-1-1909. 65 m.w. 4^{40} pm., 30 min. 2 ♀ 8 mm. — **St. 25.** ibid. 300 m.w., 5^{40} pm., 60 min. 3 ♀ 6—8 mm. — **St. 26.** 19-1-1909. 65 m.w., 0^{15} am., 60 min. 1 ♀ 4 mm. — **St. 26.** ibid. 150 m.w., 0^{50} am., 60 min. 49 spec.: 3 ♂ ad. 8—9 mm, 6 ♂ jun. 6—7 mm, 11 ♀ with ova 6—8 mm, 29 ♀ without ova 5—7 mm. — **St. 28.** 19-1-1909. 65 m.w., 11^{00} pm., 120 min. 2 ♂ ad. 8 mm. — **St. 35.**

29-1-1909. 6^{40} pm., 200 m.w., 60 min. 1 spec. jun. 3 mm. — **St. 35.** 1600 m.w., 11^{25} am., 120 min. 1 ♀ 7 mm. — **St. 38.** 31-1-1909. 25 m.w., 7^{10} pm., 30 min. 1 spec. jun. 3 mm. — **St. 39.** 1-2-1909. 1000 m.w., 0^{30} pm., 120 min. 2 spec. 5 mm: 1 ♂ jun., 1 ♀. — **St. 43.** 3-2-1909. 65 m.w., 6^{15} am., 30 min. 17 spec.: 1 ♂ ad. 9 mm, 7 ♂ jun. 7 mm, 9 ♀ 3—6 mm. — **St. 45.** 6-2-1909. 300 m.w., 11^{25} pm., 30 min. 1 ♀ 8 mm. — **St. 46.** 7-2-1909. 300 m.w., 7^{30} pm., 30 min. 1 ♂ ad. 10 mm. — **St. 47.** 10-2-1909. 65 m.w., 10^{20} pm., 30 min. 3 ♂ ad. 9—10 mm. — **St. 47.** ibid. 300 m.w., 11^{05} pm., 30 min. 1 ♀ 8 mm. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 1 spec. jun. 3 mm. — **St. 134.** 15-7-1910. 25 m.w., 4^{50} am., 30 min. 2 spec. 5 mm: 1 ♂ ad., 1 ♀. — **St. 143.** 23-7-1910. 25 m.w., 1^{20} am., 30 min. 1 ♀ 5 mm. — **St. 144.** 24-7-1910. 25 m.w., 2^{00} am., 30 min. 1 ♂ jun. 4 mm. — **St. 145.** 25-7-1910. 25 m.w., 3^{30} am., 30 min. 2 spec.: 1 ♂ ad. 6 mm, 1 ♀ 7 mm. — **St. 145.** ibid. 300 m.w., 4^{10} am., 30 min. 1 spec. jun. 3 mm. — **St. 147.** 25-7-1910. 25 m.w., 11^{35} pm., 30 min. 4 spec.: 1 ♂ ad. 8 mm, 3 ♀ 6—7 mm. — **St. 152.** 27-7-1910. 25 m.w., 10^{50} pm., 15 min. 2 spec. jun. 3—4 mm. — **St. 152.** ibid. 1000 m.w., 0^{30} am., 60 min. 1 ♀ 5 mm. — **St. 154.** 29-7-1910. Surf., 3^{40} am., 10 min. Abt. 380 spec.: 26 ♂ ad. 5—6 mm, 7 ♂ jun. 5 mm, abt. 50 spec. jun. 2 mm, abt. 300 ♀ 3—5 mm. — **St. 154.** ibid. 25 m.w., 3^{30} am., 30 min. 83 spec.: 8 ♂ ad. 6 mm, 75 ♀ 3—5 mm. — **St. 154.** ibid. 300 m.w., 4^{30} am., 30 min. 8 spec.: 2 ♂ ad. 6 mm, 6 ♀ 4—5 mm. — **St. 156.** 30-7-1910. Surf., 10 min., 2^{25} am. 7 ♀ 1—4 mm. — **St. 156.** ibid. 600 m.w., 3^{00} am., 30 min. 3 ♀ 3—6 mm. — **St. 156.** ibid. 1000 m.w., 0^{40} am., 60 min. 18 spec.: 1 ♂ ad. 7 mm, 1 ♂ jun. 6 mm, 16 ♀ 3—6 mm. — **St. 158.** 31-7-1910. Surf., 10 min., 7^{00} am. 1 ♀ 2 mm. — **St. 158.** ibid. 300 m.w., 7^{30} am., 30 min. 9 spec.: 1 ♂ ad. 7 mm, 8 ♀ 4—6 mm. — **St. 160.** 1-8-1910. 25 m.w., 2^{00} am., 30 min. 8 spec.: 1 ♂ ad. 7 mm, 2 ♂ jun. 3—4 mm, 2 ♀ 5 mm, 3 ♀ 3—4 mm. — **St. 160.** ibid. 300 m.w., 2^{45} am., 30 min. 10 spec.: 2 ♂ ad. 7 mm, 1 ♂ jun. 5 mm, 7 ♀ 4—5 mm. — **St. 160.** ibid. 1000 m.w. 3^{35} am., 60 min. 25 spec.: 2 ♂ ad. 5—7 mm, 2 ♂ jun. 5 mm, 21 ♀ 2—5 mm. — **St. 160.** ibid. 4000 m.w. 3^{30} pm. 1 ♀ 5 mm. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 8 spec.: 3 ♂ jun. 3 mm, 5 ♀ 2—4 mm. — **St. 163.** 3-8-1910. 25 m.w., 1^{05} am., 15 min. 1 ♀ 4 mm. — **St. 163.** ibid. Dredge. 1 ♂ ad. 7 mm. — **St. 179.** 13-8-1910. 65 m.w., 2^{15} am., 30 min. 2 ♀ 4—5 mm. — **St. 181.** 13-8-1910. 65 m.w., 2^{55} pm., 15 min. 4 ♀ 4—5 mm. — **St. 181.** ibid. 300 m.w., 1^{25} pm., 20 min. 1 ♀ 4 mm. — **St. 182.** 13-8-1910. 10 m.w., 11^{00} pm., 15 min. 25 spec.: 6 ♂ ad. 6 mm, 1 ♂ jun. 4 mm, 18 ♀ (6 with ova) 4—5 mm. — **St. 182.** ibid. 65 m.w., 10^{30} am., 15 min. 3 ♀ 3—5 mm. — **St. 182.** ibid. 600 m.w., 11^{40} am., 30 min. 4 spec.: 2 ♂ ad. 6 mm, 1 ♂ jun. 5 mm, 1 ♀ 5 mm. — **St. 183.** 16-8-1910. 65 m.w., 5^{10} pm., 15 min. 1 ♀ 6 mm. — **St. 189.** 19-8-1910. 300 m.w., 8^{55} am., 15 min. 1 ♂ ad. 6 mm. — **St. 193.** 21-8-1910. 10 m.w., 0^{50} am., 30 min. 2 ♀ 4 mm. — **St. 194.** 21-8-1910. Surf., 4^{35} am., 10 min. 2 ♀ 2—4 mm. — **St. 194.** ibid. 10 m.w., 4^{30} am., 15 min. 1 ♀ 3 mm. — **St. 194.** ibid. 25 m.w., 5^{00} am., 15 min. 2 ♀ 3—5 mm. — **St. 194.** ibid. 1200 m.w., 6^{00} am., 30 min. 1 ♀ 5 mm. — **St. 195.** 21-8-1910. 65 m.w., 6^{50} pm., 15 min. 1 ♀ 5 mm. — **St. 196.** 22-8-1910. 25 m.w., 2^{40} am., 30 min. 11 spec.: 2 ♂ ad. 5 mm, 9 ♀ (4 with ova) 4—5 mm. — **St. 199.** 25-8-1910. Surf., 9^{30} pm., 10 min. 1 ♀ 4 mm. — **St. 199.** ibid. 25 m.w., 9^{00} pm., 15 min. 1 ♀ 4 mm. — **St. 200.** 26-8-1910. 25 m.w., 3^{45} am., 30 min. 2 ♀ 5 mm. — **St. 205.** 27-8-1910. 25 m.w., 7^{35} pm., 15 min. 2 ♀ 4 mm. — **St. 208.** 29-8-1910. 25 m.w., 1^{40} am., 15 min. 1 ♂ ad. 5 mm, 1 ♀ 4 mm. — **St. 209.** 29-8-1910. Surf., 5^{00} am., 10 min. 1 ♂ ad. 4 mm. — **St. 209.** ibid. 25 m.w., 4^{55} am., 15 min. 1 ♀ 4 mm. — **St. 209.** ibid. 100 m.w., 3^{45} am., 20 min. 4 ♀ 4 mm. — **St. 209.** ibid. 150 m.w., 4^{25} am. 20 min. 3 ♀ 4 mm. — **St. 216.** 1-9-1910. 25 m.w., 5^{10} am., 30 min. 1 ♀ 3 mm. — **St. 276.** 36°30′ N, 19°20′ E. 4-4-1911. 132 m.w. (S. 200). 11^{20} pm., 35 min. 1 ♂ ad. 9 mm. — **St. 277.** 33°20′ N, 27°30′ E. 6-4-1911. 132 m.w. (S. 200), 11^{00} pm., 35 min. 1 ♀ 3 mm. — **St. 279.** 23-2-1911. 30 m.w. (S. 100), 7^{30} pm., 150 min. 1 ♀ 3 mm. — **St. 282.** 9-3-1911. 40 m. w. (S. 100), 2^{00} am., 90 min. 1 ♀ 4 mm. — **St. 282.** ibid. 8-3-1911. 40 m.w. (S. 100), 5^{30} pm., 90 min. 1 ♀ 5 mm. — **St. 296.** 32°10′ N, 29°50′ E. 26-6-1911. 28 m.w. (S. 200), 2^{00} am., 300 min. Abt. 150 spec.: 18 ♂ ad. 7—8 mm, 9 ♂ juv. 5—6 mm, abt. 125 ♀ 3—6 mm. — **St. 297.** 33°10′ N, 25°35′ E. 25-6-1911. 28 m.w., 11^{30} pm., 30 min. 15 spec.: 3 ♂ ad. 8—9 mm, 10 ♀ 3—4 mm, 2 ♀ 5—6 mm. — **St. 298.** 34°20′ N, 21°10′ E. 26-6-1911. 38 m.w. (S. 200), 11^{30} pm., 30 min. 27 spec.: 2 ♂ ad. 8—9 mm, 1 ♂ jun. 6 mm, 24 ♀ (3)4—5(6) mm. — **St. 339.** 40°30′ N, 3°10′ E. 20-8-1911. 28 m.w. (S. 200), 3^{00} am., 30 min. 1 ♀ 2 mm. — **St. 340.** 35°50′ N, 21°30′ E. 26-8-1911. 28 m.w. (S. 200), 9^{00} pm., 30 min. 9 spec.: 5 ♂ ad. 5 mm, 4 ♀ 4—5 mm. — **St. 340.** ibid. 108 m.w. (S. 150), 9^{00} pm., 30 min. 1 ♂ ad. 5 mm, 1 ♀ 2 mm. — **St. 341.** 34°00′ N, 26°20′ E. 27-8-1911. 28 m.w. (S. 200), 11^{00} pm., 30 min. 4 ♀ 4 mm. **St. 384.** 32°50′ N, 27°10′ E. 7-7-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. 7 spec.: 2 ♂ ad. 5 mm, 1 ♂ jun. 4 mm, 3 ♀ 4 mm, 1 ♀ 2 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911. 122 m.w. (S. 150), 8^{30} pm., 30 min. Abt. 100 spec.: 11 ♂ ad. 7 mm, 1 ♂ jun. 5 mm, 5 ♀ with ova 4—5 mm, 27 ♀ without ova 4—5 mm, abt. 50 ♀ abt. 3 mm. — **St. 411.** 40°00′ N, 13°40′ E. 5-1-1912. 112 m.w. (S. 150), 4^{15} am., 30 min.; abt. 80 spec.: 1 ♂ jun. 5 mm, 3 ♀ with ova 5—6 mm, 25 ♀ 4—5 mm, abt. 50 ♀ 2—3 mm. — **St. 412.** 34°33′ N, 24°15′ E. 7-1-1912. 112 m.w. (S. 150), 6^{30} pm., 30 min. Abt. 35 spec.: 5 ♂ ad. 5—7 mm, 1 ♀ with ova 5 mm, abt. 10 ♀ 3 mm, 20 ♀ 4—5 mm. **St. 698.** 37°20′ N, 9°25′ E. 25-2-1913. 5^{00} am. 1 ♀ 7 mm. — **St. 699.** 36°00′ N, 18°58′ E. 7-2-1913. 5^{00} am. 2 ♀ 4 mm, 1 ♀ 6 mm. — **St. 729.** 41°00′ N, 17°44′ E. 14-4-1913. 11^{30} am. 2 ♀ 3—4 mm. — **St. 730.** 38°26′ N, 13°37′ E. 16-4-1913. Abt. 170 spec.: 1 ♂ ad. 11 mm, 4 ♂ jun. 6—7 mm, 16 ♀ 6—7 mm, Abt. 150 spec. (2)3—5 mm. — **St. 731.** 37°19′ N, 1°31′ E. 19-4-1913. 2^{30} pm. 2 ♀ 3—5 mm. — **St. 743.** 34°26′ N, 20°08′ E. 23-9-1913. 10 pm. Abt. 660 spec.: abt. 60 ♂ ad. 6—7 mm, abt. 600 ♀ (several with ova 6—7 mm) (3)4—7 mm.

Atlantic.

St. 376. 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 8^{15} pm., 30 min. 12 spec.: 1 ♂ ad. 8 mm, 11 ♀ 2—5 mm. — **St. 376.** ibid. 30 m.w. (S. 100), 8^{10} pm., 30 min. 3 ♀ 4 mm. **St. 377.** 31°23′ N, 18°18′ W. 23-7-1911. 15 m.w. (S. 200). 1 ♀ with ova 5 mm, 30 ♀ 2—3 mm. — **St. 382.** 34°12′ N, 16°24′ W. 23-10-1911. 22 m.w. (S. 100). 6^{05} pm., 30 min. 11 spec.: 2 ♂ ad. 5 mm, 1 ♂ jun. 4 mm, 5 ♀ with ova 4 mm, 3 ♀ 3 mm. — **St. 383.** 37°16′ N, 14°09′ W. 23-10-1911. 30 m.w. (S. 100), 6^{05} pm., 30 min. 2 spec.: 1 ♂ ad. 6 mm, 1 ♀ 5 mm. — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. 12^{40} am., 30 min. Surf. (S. 200). 4 spec.: 1 ♂ ad. 6 mm, 3 ♀ 2—3 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200). 9^{10} pm., 30 min.

1 ♂ ad. 6 mm, 2 ♀ 2 mm. — **St. 399.** ibid. 56 m.w. (S. 150), 9^{10} pm., 30 min. 1 ♀ 4 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 9^{35} pm., 30 min. Abt. 45 spec.: 4 ♂ ad. 5—6 mm, 1 ♂ jun. 5 mm, abt. 40 ♀ 2—3 mm.

The material. There are in all abt. 2200 spec.; the species has been taken both in the Mediterranean and the Atlantic.

Mediterranean.

60 stations, 86 hauls, abt. 2078 spec. (Abt. 234 ♂, abt. 1787 ♀, abt. 57 spec. jun. [♀?]).

Chart 20. *Anchylomera Blossevillei.* ● positive stations, + negative stations (>100 m, night, 10—250 m.w.). St. 376, 377, 382, 398—400 lie outside the chart to the South West. Several of the stations lie so close to each other that it was impossible to note them all.

The distribution of stations, hauls og specimens according to months is as follows:

	stations	hauls	spec.
"Thor" Dec. 1908	1	1	1
Jan. 1909	6	9	65
Feb. —	5	6	25
June 1910	1	1	1
July —	9	16	abt. 525
Aug. —	17	30	130
Sept. —	1	1	1
total	40	64	abt. 750
collected by other vessels	20	22	abt. 1328
total	60	86	abt. 2078

In the Mediterranean the species thus belongs to the most widely distributed Hyperiidea.

Depth of the sea and occurrence.

As will be seen from the table, the species is to be found at all depths except the lowest (< 75 m), and it is distributed over both basins of the Mediterranean; it has, indeed, been found in the southern part of the Adriatic and penetrates nearly to the Dardanelles, whereas curiously enough it has not been found in the western part of the Mediterranean (West of 0°).

Depths in m.	No. of stations	
	Total no. ("Thor" the other vessels)	"Thor" 1908—10
0— 500	13	9
> 500—1000	5	5
> 1000—2000	13	11
> 2000—3000	19	11
> 3000	10	4

Taking stations ("Thor" 1908—10) with a depth > 100 m, there are in the western basin 21 positive stations as against 40 negative stations (night, 0—250 m. w.) i. e. abt. 34 per cent. positive stations. In the eastern basin there are 16 positive as against 12 negative stations i. e. abt. 57 per cent. positive stations. It is thus comparatively more numerous in the eastern than in the western basin. Inside the Dardanelles there are 3 negative stations, no positive ones.

Vertical occurrence. As the species can be found at comparatively small depths (13 stations have a depth < 500 m) no tables are given to show the abundancy of the hauls in percentage, according to depth.

M. w.	No. of hauls "Thor" 1908—10	
	Night	Day
10— 35	28	1
50—100	6	6
130—250	3	—
300—400	6	4
>400	6	4
total	49	15

The species is to be found at the same depth in the two basins; at night chiefly at the surface, by day taken especially with 50—100 m. w.

On an average, only a few specimens were taken pr. haul (2—4 pr. normal haul of 30 min.), but shoals have been encountered in the eastern basin both in winter and summer: 660 spec. (St. 743), 380 spec. (10 min.; St. 154, 1910, surf.); 170 spec. (St. 730), 150 spec. (St. 296), 100 spec. (St. 385), 80 spec. (St. 411), 49 spec. (St. 26), 35 spec. (St. 412), 27 spec. (St. 298), 25 spec. (St. 160). If the hauls are referred to normal

hauls (30 min.), the western basin (night, 10—35 m. w.) has given 52 spec., the eastern basin 1235 spec.

Size and propagation. In the Mediterranean, the "Thor" herself caught about 750 spec. (101 ♂, about 592 ♀, about 57 juv. [♀?]) and the other vessels about 1328 spec. (about 138 ♂, about 1190 ♀), in all about 2078 spec. (about 239 ♂, about 1782 ♀, about 57 jun.); or in other words about 7 times as many females as males.

The size of ♂ ad. varies between 5 and 11 mm; the greater part are 6—7—8 mm, but quite a number may be 5 or even 10—11 mm. ♂ juv. is 3—7 mm, most frequently 5—6 mm.

♀ without ova are as a rule 5—7 mm; the extreme limits are 4—8 mm, but I believe that all the young of 2—4 mm, which have not been determined as to sex are in reality ♀.

♀ with ova are 4—8 mm, most frequently 5—7 mm, ♀ with ova or embryos have been found in Jan., Aug., Sept. and November; the species thus propagates all the year round.

Atlantic.

There are altogether about 112 spec. (12 ♂, about 100 ♀) from 7 stations, 9 hauls; the most northerly locality is 37°16′ N (St. 383). The depth of the sea varies between > 1100 m and > 4500 m.

Distribution.

1. Mediterranean. Curiously enough, only very few previous writers have recorded this extremely common species from the Mediterranean: Capri, 1 ♀ juv. 1700 m. w., daytime, depth 1100 m (Lo Bianco 1903). — Mediterranean without locality (Bovallius). — Our Zool. Museum has specimens from 37°1′ N, 16°51′ E, and from Messina. — (Is not mentioned by Steuer 1913 from the Adriatic). ?*A.n. sp.*?, Chun 1887, see above p. 134.

2. Atlantic. The most important material mentioned in the literature is that taken by the German Plankton-Expedition (Vosseler 1901); it contains 176 spec. (17 ♂ ad., 38 ♂ jun., 4 ♀ ad., 117 ♀ jun.) from 32 hauls. Only 3 hauls contain more than some few specimens: 17, 40 and 47 spec. The localities are as follows: Florida Current 3 st. 41.6° N, 56.3° W, to 37.9° W, 59.1° W, 0 or 0—200 m. Sargasso Sea 11 st.: 37.1° N, 59.9° W; 34.7° N, 62.2° W to 31.2° N, 56.4° W; 31.4° N, 46.6° W; 31.7° N, 42.7° W to 23.7° N, 36° W; 25.6° N, 34.9° W, and 27.8° N, 33.3° W; 0 or 0—400 (200) m. N. Equatorial Current 4 st. 28.9° N, 35° W to 24.6° N, 31° W, 0—400 m. S. Equatorial Current 14 st.: 1.7° N, 17.3° W, to 7.5° S, 20.3° W, and 5.7° S, 26.5° W, to 5.6° N, 4.4° W, 0 to 0—500 m.

The Copenhagen Zoological Museum possesses specimens from the following localities (specimens from the Indian Ocean, see below), seen by Bovallius: 42°50′ N, 46°10′ W; 36°22′ N, 40°48′ W; 36°6′ N, 39°28′ W; 32°16′ N, 38°1′ W; 31°30′ N, 26°20′ W; 31°30′ N, 19° 20′ W; 30°34′ N, 30°50′ W; 30° N, 17°40′ W; 27°53′ N, 23°3′ W; 25°5′ N, 32° W; 25° N, 28° W; 24° N, 32° W; 23½° N, 35½° W; 21°30′ N, 28° W; 20° N, 36° W; 5°3′ N, 23°15′ W; 0°30′ N, 29° W; 11°50′ S, 8°11′ W; 15°6′ S, 16° W; 15°19′ S, 24°54′ W; 20°14′ S, 1°4′ W; 25°20′ S, 7° E; 26°20′ S, 20° W; 26°30′ S, 4°36′ E; 26°30′ S, 8°20′ E; 26°30′ S, 34°40′ W; 28°40′ S, 10°35′ E; 29° S, 37°23′ W; 29°30′ S, 12° E; 32°30′ S, 15° E; 37°40′ S, 12° E. —

Southern New England (Holmes, Bull. Bur. Fish., Washington, vol. 24, 1904 (1905), p. 465). — Between Tenerife and St. Thomas, West Indies, 5 spec.; 3°10′ N, 14°51′ W, 0—200 fms., 1 spec.; 0°15′ S, 14°25′ W, surf., 1 spec. (Stebbing, "Challenger"). — 19°13′ S, 39°35′ W (near Bahia) (Stewart 1913). — 4 localities 40½°—42⅚° N, 38°53′—45°25′ W, surf., 9—10³⁰ pm. (Chevreux 1900).

From these localities it may be seen that the species is very common in the Atlantic between a line from abt. 40° N at America to abt. 43° N. S to E of New Foundland and from there to abt. 35° N at the European side, — and to the South to abt. 38° S.

3. Indian Ocean. The Copenhagen Zoological Museum possesses specimens from the following localities, at all events partly seen by Bovallius: 11°15′ S, 103° 50′ E; 12° S, 103°50′ E; 13° S, 103°20′ E; 27°30′ S, 98° E; 27°40′ S, 58°30′ E; 27° S, 47°50′ E; 28°40′ S, 51°40′ E; 32°40′ S, 55°20′ E; 32°15′—33° S, 58°—58½° E; 33°50′ S, 56° E; 34° S, 36° E; 35° S, 55° E; 38°29′ S, 29°30′ E; 38°20′ S, 30° E; 38°28′ S, 40° E; 28°54′ S, 41°30′ E.

Off Salomon Atoll (abt. 6° S, 72° E), surf., and N of Saya de Malha Bank (abt. 9° S, 60°—62° E), surf. (Walker 1909),

4. Pacific. The Zoological Museum has specimens from the following localities, taken by the "Galatea"-Exped.: China Sea 14°6′ N, 119°21′ E; Yeddo Bay, and Japan without locality.

The "Challenger"-Exped. has taken the species at the following localities: Off Port Jackson, surf., night; between Sidney and Wellington, surf.; between Api (New Hebrides) and Cape York (N. Australia), surf.; 3 times S of Japan 24¾°—26½° N, 138°—138½° E, surf.; between Japan and Papua, surf., and twice between Honolulu and Japan, surf.

Symbiosis. *"Phrosina macrophthalma"* is found in *Pyrosoma elegans* (Risso, *teste* Carus, Prodromus p. 423); otherwise nothing is known about symbiosis.

2. Genus Phrosina Risso.

Phrosina Stebbing 1888, p. 1424 (lit.). — *P.* Bovallius 1889, p. 421 (lit.).

1. PHROSINA SEMILUNATA Risso (Chart 21).

**Phrosina semilunata* Stebbing 1888, p. 1425 (lit.), Pl. 176. — *P. s.* Bovallius 1889, p. 426 (lit.), Pl. 18 figs. 3—30. — *P. s.* Vosseler 1901, p. 89, Pl. 8 figs. 18—20.

Mediterranean.

St. 10. 15-12-1908. 25 m.w., 5^{00} am., 60 mi.n 1 ♀ 5 mm. - **St. 10.** ibid. 600 m.w., 3^{45} pm., 60 min. 1 ♀ 5 mm. — **St. 12.** 19-12-1908. 65 m.w. 1^{00} pm., 30 min. 1 ♀ 5 mm. — **St. 13.** 19-12-1908. 65 m.w. 8^{50} pm., 60 min., 2 ♀ 10-13 mm. — **St. 26.** 19-1-1909. 25 m.w., 4^{20} am., 120 min. 8 ♀ 6—9 mm. — **St. 26.** ibid. 65 m.w., 0^{15} am., 60 min. 3 ♀ 8—11 mm. — **St. 26.** ibid. 150 m.w., 0^{50} am., 60 min. 1 ♀ 17 mm. — **St. 26.** ibid. 300 m.w., 6^{40} am., 180 min. 2 ♀ 8—11 mm. — **St. 28.** 19-1-1909. 200 m.w., 9^{00} pm., 30 min. 1 ♀ 15 mm. — **St. 28.** ibid. 400 m.w., 6^{40} pm., 30 min. 1 ♀ 13 mm. — **St. 30.** 21-1-1909. 300 m.w., 7^{10} am., 60 min. 1 ♀ 11 mm. — **St. 35.** 28-1-1909. 300 m.w., 9^{40} pm., 120 min. 2 ♀ 9—12 mm. — **St. 36.** 30-1-1909. 65 m.w., 5^{35} am., 60 min. 2 ♀ 5 mm, 2 ♀ 11—14 mm. — **St. 38.** 31-1-1909. 65 m.w., 6^{30} pm., 30 min. 1 ♂ jun. 5 mm. — **St. 39.** 1-2-1909. 300 m.w., 7^{15} am., 60 min. 1 ♀ 7 mm. — **St. 42.** 2-2-1909. 300 m.w., 9^{40} pm., 30 min. 7 spec.: 1 ♂ ad. 7 mm, 1 ♂ jun. 7 mm, 2 ♀ 5 mm, 2 ♀ 8 mm, 1 ♀ 13 mm. — **St. 43.** 3-2-1909. 65 m.w., 6^{15} am., 30 min. 2 ♀ 10—12 mm. — **St. 45.** 7-2-1909. 65 m.w., 0^{15} am., 30 min. 3 ♀ 8—13 mm. — **St. 45.** ibid. 300 m.w., 11^{25} pm., 30 min. 4 ♀: 9, 17, 19, 22 mm. — **St. 46.** 7-2-1909. 300 m.w., 7^{30} pm., 30 min. 1 ♀ 21 mm. — **St. 46.** ibid. 600 m.w., 6^{25} pm., 30 min. 5 spec.: 1 ♂ ad. 6 mm, 4 ♀ 7, 9, 10, 19 mm. — **St. 47.** 10-2-1909. 65 m.w., 10^{20} pm., 30 min. 24 spec.: 1 ♂ jun. 5 mm, 15 ♀ 3—6 mm, 7 ♀ 8—9 mm, 1 ♀ 13 mm. — **St. 47.** ibid. 300 m.w., 11^{05} pm., 30 min. 6 spec.: 3 ♂ jun. 3—4 mm, 3 ♀ 5—8 mm. — **St. 50.** 17-2-1909. 65 m.w., 2^{00} am., 30 min. 1 ♀ 13 mm. — **St. 51.** 18-2-1909. 300 m.w., 0^{50} am., 30 min. 1 ♀ 8 mm. — **St. 52.** 18-2-1909. 300 m.w., 7^{25} am., 30 min. 7 ♀: 1 ♀ 5 mm, 4 ♀ 7 mm, 2 ♀ 10 mm. — **St. 53.** 18-2-1909. 2600 m.w., 5^{15} pm., 90 min. 1 ♀ 4 mm. — **St. 55.** 19-2-1909. 25 m.w., 6^{40} am., 60 min. 3 ♀ 6—11 mm. — **St. 57.** 20-2-1909. 25 m.w., 5^{45} am., 30 min. 2 ♀ 6—9 mm. — **St. 57.** ibid. 200 m.w., 6^{30} am., 30 min. 11 spec.: 1 ♂ jun. 4 mm, 9 ♀ 4—8 mm, 1 ♀ 15 mm. — **St. 58.** 20-2-1909. 65 m.w., 3^{00} pm., 30 min. 7 ♀: 4 ♀ 4 mm, 2 ♀ 6 mm, 1 ♀ 18 mm. — **St. 59.** 21-2-1909. 1200 m.w., 2^{30} am., 60 min. 1 ♀ 17 mm. — **St. 104.** 26-6-1910. 65 m.w., 6^{20} pm., 30 min. 74 spec.: 17 ♂ jun. (3)4 mm, 16 ♂ ad. 5 mm, 25 ♀ 4—5 mm, 9 ♀ 6—7 mm, 7 ♀ 8—14 mm. — **St. 106.** 25-6-1910. 65 m.w., 2^{30} am., 30 min. 10 ♀ 4—5 mm. — **St. 106.** ibid. 300 m.w., 1^{45} am., 30 min. 10 spec.: 2 ♂ jun. 3—4 mm, 8 ♀ 3—5 mm. — **St. 106.** ibid. 1200 m.w., 0^{20} am., 60 min. 1 ♂ ad. 6 mm, 1 ♀ 5 mm. — **St. 107.** 25-6-1910. 65 m.w., 9^{50} am., 15 min. 31 spec.: 5 ♂ ad. 5 mm, 9 ♂ jun. 4 mm, 8 ♀ 3—6 mm, 3 ♀ 7 mm, 6 ♀ 8—14 mm. — **St. 107.** ibid. 2000 m.w., 7^{30} am., 60 min. 1 ♂ jun. 4 mm, 1 ♀ 13 mm. — **St. 108.** 25-6-1910. 300 m.w., 10^{30} pm., 30 min. 15 spec.: 2 ♂ jun. 4 mm, 10 ♀ 4—6 mm, 3 ♀ 8—11 mm. — **St. 108.** ibid. 2000 m.w., 0^{40} am., 60 min. 1 ♂ jun. 5 mm. — **St. 112.** 27-6-1910. 25 m.w., 1^{30} am., 15 min. Abt. 60 spec.: 5 ♂ jun. 4 mm, abt. 50 ♀ 3—4 mm, 3 ♀ 5 mm. — **St. 112.** ibid. 65 m.w., 1^{05} am., 15 min. 1 ♂ jun. 4 mm, 8 ♀ 4 mm. — **St. 112.** ibid. 300 m.w., 0^{15} am., 30 min. 13 spec.: 2 ♂ ad. 7 mm, 3 ♂ jun. 5 mm, 5 ♀ 4—6 mm, 3 ♀ 7—9 mm, 2 ♀ 14—19 mm. — **St. 113.** 28-6-1910. 300 m.w., 3^{25} am., 30 min. 37 spec.: 6 ♂ ad. 5 mm, 3 ♂ jun. 4—5 mm, 6 ♀ 5—6 mm, 12 ♀ 8—9 mm, 9 ♀ 11—13 mm, 1 ♀ 18 mm. — **St. 115.** 29-6-1910. 25 m.w., 1^{40} am., 15 min. 13 spec.: 1 ♂ jun. 4 mm, 2 ♀ 3 mm, 5 ♀ 5 mm, 5 ♀ 6—9 mm. — **St. 115.** ibid. 65 m.w., 1^{20} am., 15 min. 4 spec.: 1 ♂ jun. 4 mm., 3 ♀ 2—3 mm. — **St. 115.** ibid. 300 m.w., 11^{20} pm., 30 min. 6 spec.: 1 ♀ 11 mm, 5 ♂ ad. 5 mm. — **St. 115.** ibid. 2000 m.w., 0^{30} am., 60 min. 1 ♀ 4 mm. — **St. 116.** 30-6-1910. 25 m.w., 3^{00} am., 15 min. 15 ♀ 3—4 mm. — **St. 116.** ibid. 300 m.w., 4^{05} pm., 30 min. 1 ♂ jun. 4 mm, 1 ♀ 4 mm. — **St. 118.** 1-7-1910. 25 m.w., 0^{20} am., 15 min. Abt. 85 spec.: 12 ♂ jun. 3—4 mm, abt. 75 ♀ 3—5 mm. — **St. 118.** ibid. 65 m.w., 11^{35} pm., 30 min. 22 spec.: 1 ♂ ad. 5 mm, 2 ♀ 4 mm, 1 ♀ 5 mm, 10 ♀ 7—8 mm, 8 ♀ 10—13 mm. — **St. 118.** ibid. 300 m.w., 10^{55} pm., 30 min. 8 spec.: 1 ♂ ad. 5 mm, 5 ♀ 4—5 mm, 1 ♀ 11 mm, 1 ♀ 30 mm. — **St. 120.** 1-7-1910. 300 m.w., 8^{50} pm., 30 min. 5 spec.: 4 ♂ (1 jun., 3 ad.) 5 mm, 1 ♀ 5 mm. — **St. 121.** 2-7-1910. 25 m.w., 3^{35} am., 30 min. 12 spec.: 1 ♂ ad. 5 mm, 3 ♂ jun. 4 mm, 7 ♀ 3—5 mm, 1 ♀ 7 mm. — **St. 122.** 2-7-1910. 600 m.w., 10^{00} am., 60 min. 1 ♂ ad. 5 mm. — **St. 122.** ibid. 1200 m.w., 5^{30} pm., 60 min. 2 spec.: 1 ♂ ad. 5 mm, 1 ♀ 4 mm. — **St. 123.** 3-7-1910. 10 m.w., 2^{30} am., 15 min. 2 ♀ 5—6 mm. — **St. 123.** ibid. 25 m.w., 1^{50} am., 15 min. Abt. 60 spec.: 5 ♂ ad. 5 mm, 9 ♂ jun. 4 mm, abt. 40 ♀ 3—4 mm, 7 ♀ 7—8 mm. — **St. 123.** ibid. 65 m.w., 0^{55} am., 30 min. Abt. 450 spec.: 5 ♂ ad. 6 mm, abt. 30 ♂ jun. 4—5 mm, abt. 400 ♀ 3—7 mm, 20 ♀ 8—10 mm. — **St. 123.** ibid. 300 m.w., 0^{05} am., 30 min. 18 spec.: 9 ♂ ad. 5—6 mm, 8 ♀ 4—5 mm, 1 ♀ abt. 10 mm (defective). — **St. 125.** 9-7-1910. 25 m.w., 10^{30} pm., 30 min. 14 spec.: 5 ♂ ad. 5—6 mm, 2 ♂ jun. 4 mm, 6 ♀ 6—7 mm, 1 ♀ 9 mm. — **St. 125.** ibid. 300 m.w., 9^{45} pm., 30 min. 3 spec.: 1 ♂ ad. 6 mm, 1 ♂ jun. 4 mm, 1 ♀ 5 mm. — **St. 126.** 10-7-1910. 25 m.w., 10^{10} pm., 30 min. 1 ♀ 5 mm. — **St. 126.** ibid. 300 m.w., 9^{30} pm., 30 min. 2 spec.: 1 ♂ ad. 6 mm, 1 ♀ 5 mm. — **St. 129.** 12-7-1910. 25 m.w., 3^{00} am., 30 min. Abt. 100 spec.: abt. 90 ♀ 3—4 mm, abt. 10 ♂ jun. 4 mm. — **St. 129.** ibid. 300 m.w., 3^{40} am., 30 min. 6 spec.: 2 ♂ ad. 6 mm, 4 ♀ 4—6 mm. — **St. 129.** ibid. 600 m.w., 8^{00} pm., 30 min. 7 spec.: 1 ♂ ad. 6 mm, 6 ♀ 3—6 mm. — **St. 129.** ibid. 1000 m.w., 4^{20} am., 60 min. 6 ♀ 3—8 mm. — **St. 129.** ibid. 3500 m.w., 3^{00} pm., 120 min. 3 spec. 5 mm: 1 ♂ ad., 2 ♀. — **St. 130.** 13-7-1910. 0^{50} am., 25 m.w., 30 min. 69 spec. 3—5 mm: 2 ♂ ad. 5 mm, 14 ♂ jun., 53 ♀. — **St. 131.** 13-7-1910. 300 m.w., 10^{25} am., 30 min. 11 spec.: 1 ♂ ad. 5 mm, 1 ♂ jun. 4 mm, 5 ♀ 3 mm, 2 ♀ 4—5 mm, 2 ♀ 6—8 mm. — **St. 131.** ibid. 1000 m.w., 11^{40} am., 60 min. 1 ♂ 5 mm. — **St. 132.** 14-7-1910. 25 m.w., 3^{05} am., 30 min. 10 ♀ 3 mm. — **St. 132.** ibid. 300 m.w., 3^{45} am., 30 min. 6 spec.: 2 ♂ ad. 5 mm, 2 ♂ jun. 4 mm, 2 ♀ 9—10 mm. — **St. 132.** ibid. 600 m.w., 4^{50} am., 30 min. 3 spec.: 2 ♂ jun. 4 mm, 1 ♂ ad. 6 mm. —

St. 133. 14-7-1910. 25 m.w., 11^{00} pm., 30 min. 6 spec.: 1 ♂ jun. 2 mm, 5 ♀ 2—4 mm. — **St. 133.** ibid. 300 m.w., 10^{15} pm., 30 min. 10 spec.: 1 ♂ ad. 6 mm, 2 ♂ jun. 4 mm, 6 ♀ 4—6 mm, 1 ♀ 9 mm. — **St. 133.** ibid. 600 m.w., 9^{20} pm., 30 min. 2 ♀ 6 mm. — **St. 134.** 15-7-1910. 25 m.w., 4^{50} am., 30 min. 10 spec.: 2 ♂ jun. 3—4 mm, 8 ♀ 3—6 mm. — **St. 134.** ibid. 300 m.w., 5^{40} am., 30 min. 7 spec.: 1 ♂ ad. 6 mm, 2 ♂ jun. 3—4 mm, 2 ♀ 3—5 mm, 2 ♀ 10—12 mm. — **St. 135.** 16-7-1910. 25 m.w., 12^{05} am., 30 min. 6 spec.: 1 ♂ jun. 4 mm, 5 ♀ 5—6 mm. — **St. 137.** 19-7-1910. 25 m.w., 8^{15} am., 30 min. 5 ♀ 2—5 mm. — **St. 137.** ibid. 250 m.w., 9^{05} am., 30 min. 7 spec.: 5 ♂ ad. 6 mm, 2 ♀ 3—10 mm. — **St. 138.** 19-7-1910. 25 m.w., 9^{50} pm., 30 min. 1 ♂ jun. 4 mm, 3 ♀ 3—4 mm. — **St. 138.** ibid. 300 m.w., 9^{10} pm., 30 min. 64 spec.: 1 ♂ ad 6 mm, 10 ♂ jun. 4—5 mm. 51 ♀ 3—6 mm, 2 ♀ 9 mm. — **St. 138.** ibid. 1000 m.w., 7^{40} pm., 60 min. 8 spec.: 1 ♂ ad. 5 mm, 1 ♂ jun. 4 mm, 6 ♀ 3—5 mm. — **St. 139.** 20-7-1910. 1^{40} am., 25 m.w., 30 min. 2 ♂ jun. 5 mm. **St. 141.** 20-7-1910. 25 m.w., 10^{35} pm., 15 min. 1 ♀ 5 mm. — **St. 142.** 22-7-1910. 25 m.w., 2^{50} am., 30 min. 1 ♂ jun. 4 mm, 2 ♀ 3 mm. — **St. 142.** ibid. 150 m.w., 3^{40} am., 30 min. 5 spec.: 1 ♂ ad. 15 mm, 3 ♂ jun. 3—4 mm, 1 ♀ 3 mm. — **St. 143.** 23-7-1910. 25 m.w., 1^{20} am., 30 min. 35 spec.: 2 ♂ ad. 5 mm, 3 ♂ jun. 4 mm, 17 ♀ 3—7 mm, 13 ♀ 8—14 mm. — **St. 143.** ibid. 300 m.w., 0^{30} am., 30 min. 2 ♂ ad. 4—5 mm, 1 ♀ 17 mm. — **St. 143.** ibid. 1000 m.w., 2^{00} am., 60 min. 1 ♀ 14 mm. — **St. 144.** 24-7-1910. 25 m.w., 2^{00} am., 30 min. 2 ♀ 3—4 mm. — **St. 145.** 25-7-1910. 300 m.w., 4^{10} am., 30 min. 2 ♀ 4—5 mm. — **St. 147.** 25-7-1910. 25 m.w., 11^{35} pm., 30 min. 35 spec.: 6 ♂ jun. 4 mm, 23 ♀ 3—6 mm, 5 ♀ 7—8 mm, 1 ♀ 10 mm. — **St. 147.** ibid. 1000 m.w., 1^{10} am., 60 min. 3 spec.: 1 ♂ ad. 6 mm, 1 ♂ jun. 4 mm., 1 ♀ 3 mm. — **St. 147.** ibid. 300 m.w., 0^{20} am., 30 min. 8 spec.: 1 ♂ jun. 4 mm, 4 ♀ 4—6 mm, 3 ♀ 8—13 mm. — **St. 152.** 300 m.w., 11^{35} pm., 30 min. 4 spec.: 3 ♂ ad. 6 mm, 1 ♀ 10 mm. — **St. 132.** ibid. 1000 m.w., 0^{30} am., 60 min. 2 ♂ ad. 6 mm. — **St. 156.** 30-7-1910. 25 m.w., 2^{15} am., 30 min. 11 spec.: 5 ♂ jun. 4—5 mm, 6 ♀ 3—6 mm. — **St. 156.** ibid. 300 m.w., 3^{50} am., 30 min. 1 ♀ 3 mm. — **St. 156.** ibid. 600 m.w., 3^{00} am., 30 min. 1 ♀ 27 mm (with embryos). — **St. 156.** ibid. 1000 m.w., 0^{40} am., 60 min. 2 ♂ ad. 5 mm. — **St. 158.** 31-7-1910. 300 m.w., 7^{30} am., 30 min. 6 spec.: 5 ♀ 5—6 mm, 1 ♀ 9 mm. — **St. 160.** 1-8-1910. 25 m.w., 2^{00} am., 30 min. 5 spec.: 1 ♂ 5 mm., 4 ♀ 3—6 mm. — **St. 160.** ibid. 300 m.w., 2^{45} am., 30 min. 8 spec.: 1 ♂ ad. 5 mm, 2 ♂ jun. 4 mm, 2 ♀ 5—6 mm, 1 ♀ with embryos 21 mm, 2 ♀ 16 mm. — **St. 160.** ibid. 1000 m.w., 3^{35} am., 60 min. 6 spec.: 3 ♂ ad. 5 mm, 2 ♂ jun. 4 mm, 1 ♀ 6 mm. — **St. 160.** ibid. 4000 m.w., 3^{30} pm., 60 min. 4 spec.: 1 ♂ ad. 5 mm, 2 ♀ 4 mm, 1 ♀ 9 mm. — **St. 161.** 2-8-1910. 25 m.w., 3^{00} am., 30 min. 19 spec.: 2 ♂ ad. 5 mm, 3 ♂ jun. 4 mm, 13 ♀ 3—5 mm, 1 ♀ 7 mm. — **St. 163.** 3-8-1910. 25 m.w., 1^{35} am., 15 min. 1 ♀ 3 mm. — **St. 163.** ibid. 300 m.w., 1^{05} am., 15 min. 2 ♀ 5—13 mm. — **St. 163.** ibid. 1000 m.w. 0^{05} am., 30 min. 1 ♂ 5 mm. — **St. 179.** 13-8-1910. 65 m.w., 2^{15} am., 30 min. 5 spec.: 1 ♂ ad. 5 mm, 3 ♀ 3—4 mm, 1 ♀ 15 mm. — **St. 181.** 13-8-1910. 65 m.w., 2^{55} pm., 15 min. 2 ♀ 7 mm. — **St. 182.** 13-8-1910. 10 m.w., 10^{00} pm., 15 min. 2 ♀ 4—6 mm. — **St. 182.** ibid. 65 m.w., 10^{30} pm., 15 min. 2 ♂ jun. 4 mm. — **St. 182.** ibid. 600 m.w., 11^{40} pm., 30 min. 5 spec.: 2 ♂ ad. 5 mm, 1 ♂ jun. 3 mm, 2 ♀ 5—7 mm. — **St. 192.** 28-8-1910. 25 m.w., 9^{40} pm., 15 min. 1 ♀ 3 mm. — **St. 192.** ibid. 300 m.w., 10^{10} pm., 15 min. 1 ♂ jun. 4 mm. — **St. 192.** ibid. 600 m.w., 10^{50} pm., 30 min. 4 ♂: 3 ♂ ad. 6 mm, 1 ♂ jun. 4 mm. — **St. 193.** 21-8-1910. 10 m.w., 0^{50} am., 30 min. 9 spec.: 2 ♂ jun. 3—4 mm, 5 ♀ 4—5 mm, 2 ♀ 7 mm. — **St. 194**: 21-8-1910. 25 m.w., 5^{00} am., 15 min. 9 spec.: 4 ♂ jun. 2—3 mm, 4 ♀ 3 mm, 1 ♀ 8 mm. — **St. 194.** ibid. 1200 m.w., 6^{00} am., 30 min. 1 ♂ jun. 3 mm. — **St. 195.** 21-8-1910. 65 m.w., 6^{50} pm., 15 min. 2 ♀ 3—4 mm. — **St. 196.** 22-8-1910. 25 m.w., 2^{40} am., 30 min. 2 ♂ jun. 3—4 mm. — **St. 197.** 24-8-1910. 25 m.w., 7^{45} pm., 15 min. 14 spec.: 8 ♂ jun. 3—4 mm, 6 ♀ 3—4 mm. — **St. 199.** 28-8-1910. 300 m.w., 9^{25} pm., 20 min. 4 spec.: 1 ♂ ad. 5 mm, 3 ♀ 5, 8, 5 mm. — **St. 200.** 26-8-1910. 25 m.w., 3^{45} am., 30 min. 3 ♀ 6 mm. — **St. 202.** 26-8-1910. 300 m.w., 5^{05} pm., 15 min. 1 ♀ 5 mm. — **St. 204.** 27-8-1910. 25 m.w., 4^{00} am., 15 min. 30 spec.: 1 ♂ ad. 5 mm, 4 ♂ jun. 3—4 mm, 13 ♀ 6—10 mm, 12 ♀ 3—5 mm. — **St. 204.** ibid. 65 m.w., 4^{30} am., 15 min. 1 ♂ jun. 4 mm, 2 ♀ 5—9 mm. — **St. 205.** 27-8-1910. 25 m.w., 7^{35} pm., 15 min. 13 spec.: 4 ♂ jun. 4 mm, 7 ♀ 3—4 mm, 2 ♀ 7 mm. — **St. 206.** 28-8-1910. 300 m.w., 1^{05} am., 15 min. 15 spec.: 8 ♂ ad. 5—6 mm, 2 ♂ jun. 4—5 mm, 5 ♀ 4—6 mm. — **St. 206.** ibid. 1000 m.w., 1^{40} am., 45 min. 4 spec.: 1 ♂ ad. 5 mm, 3 ♀ 4—8 mm. — **St. 206.** ibid. 2000 m.w. 3^{05} am., 45 min. 2 spec.: 1 ♂ ad. 5 mm, 1 ♂ jun. 4 mm. — **St. 207.** 28-8-1910. 25 m.w., 8^{40} pm., 15 min. 2 spec.: 1 ♂ jun. 4 mm, 1 ♀ 4 mm. — **St. 207.** ibid. 65 m.w., 9^{20} pm., 15 min. 1 ♀ 3 mm. — **St. 207.** ibid. 1000 m.w., 6^{00} am., 45 min. 3 ♂ ad. 5—6 mm. — **St. 208.** 29-8-1910. Surf. (P. 100), 1^{45} pm., 10 min. 1 ♂ jun. 4 mm. — **St. 208.** ibid. 25 m.w., 1^{40} am., 15 min. 7 spec.: 3 ♂ jun. 3—4 mm, 4 ♀ 3—7 mm. — **St. 209.** 29-8-1910. Surf. (P. 100), 5^{00} am., 10 min. 1 ♀ 4 mm. — **St. 209.** ibid. 25 m.w., 4^{55} am., 15 min. 36 spec.: 11 ♂ jun. 3—5 mm, 18 ♀ 3—4 mm, 7 ♀ 5—7 mm. — **St. 209.** ibid. Vertic. 35—0 m, 5^{35} pm. 1 ♀ 2 mm. — **St. 209.** ibid. Vertic. 75—35 m. 4^{10} pm. 3 ♀ 1—2 mm. — **St. 209.** ibid. 100 m.w., 3^{45} pm., 20 min. 8 spec.: 5 ♂ jun. 3—4 mm, 3 ♀ 2—6 mm. — **St. 209.** ibid. 150 m.w., 4^{25} pm., 20 min. 30 spec.: 10 ♂ jun. 3—4 mm, 18 ♀ 3 mm, 2 ♀ 7 mm. — **St. 209.** ibid. 300 m.w., 5^{25} am., 15 min. 5 spec.: 1 ♂ ad. 6 mm, 3 ♂ jun. 4 mm, 1 ♀ 2 mm. — **St. 209.** ibid. 2000 m.w., 7^{25} am., 45 min. 13 spec.: 5 ♂ ad. 6 mm, 3 ♂ jun. 4 mm, 5 ♀ 2—4 mm. — **St. 210.** 30-8-1910. 25 m.w., 2^{45} am., 30 min. 3 spec.: 1 ♂ jun. 3 mm, 2 ♀ 2—4 mm. — **St. 210.** ibid. 600 m.w., 3^{35} am., 30 min. 12 spec.: 2 ♂ ad. 6 mm, 8 ♀ 3—8 mm, 2 ♀ 9—13(?) mm. — **St. 216.** 1-9-1910. 25 m.w., 5^{10} am., 30 min. 4 spec.: 1 ♂ jun. 4 mm, 1 ♀ 3 mm, 2 ♀ 5 mm. — **St. 217.** 1-9-1910. 300 m.w., 1^{40} pm., 30 min. 9 spec.: 2 ♂ ad. 5—6 mm, 3 ♂ jun. 4 mm, 2 ♀ 3 mm, 2 ♀ 7—14 mm. — **St. 218.** 2-9-1910. 300 m.w., 2^{45} am., 30 min. 1 ♀ 15 mm(?). — **St. 222.** 4-9-1910. 300 m.w., 11^{20} pm., 30 min. 10 spec.: 4 ♂ ad. 6 mm, 5 ♀ 8—12 mm, 1 ♀ with ova 22 mm. — **St. 223.** 5-9-1910. 25 m.w., 4^{35} am., 15 min. 2 spec.: 1 ♂ jun. 4 mm, 1 ♀ 5 mm. — **St. 223.** ibid. 300 m.w., 4^{35} am., 30 min. 2 ♀ 11—25 mm. — **St. 224.** 5-9-1910. 300 m.w., 7^{20} pm., 30 min. 11 spec.: 4 ♂ jun. 4 mm, 4 ♀ 3—5 mm, 1 ♀ 7 mm, 2 ♀ 12—18 mm. — **St. 225.** 6-9-1910. 25 m.w., 3^{30} am., 15 min. 12 ♀ 4—5 mm. — **St. 227.** 6-9-1910. 25 m.w., 5^{55} pm., 30 min. 1 ♀ 5 mm. — **St. 228.** 7-9-1910. 300 m.w., 1^{55} am., 30 min. 1 ♀ 25 mm. — **St. 275.** 39°5′ N, 14°50′ E. 3-4-1911. 94 m.w. (S. 200), 8^{30} pm., 30 min. 3 spec.: 2 ♂ jun. 3—4 mm, 1 ♀ 5(?) mm. — **St. 276.** 36°30′ N, 19°20′ E. 4-4-1911. 132 m.w. (S. 200). 11^{20} pm., 35 min. 14 spec.: 5 ♂ jun. 4 mm, 8 ♀ 3—5 mm, 1 ♀ 8 mm. — **St. 277.** 33°20′ N, 27°30′ E. 6-4-1911. 132 m.w. (S. 200), 11^{00} pm., 35 min. 1 ♀ 8 mm. — **St. 279.** 38°11.5′ N, 15°36.5′ E. 23-2-1911. 30 m.w.

(S. 100), 7^{00} pm., 150 min. 2 ♀ 2—6 mm. — **St. 281.** 38°15′ N, 15°37.5′ E. 1-3-1911. 10 m.w. (S. 100), 4^{55} pm., 120 min. 2 ♀ 2—3 mm. — **St. 281.** ibid. 40 m.w. (S. 100), 6^{10} pm., 120 min. 2 ♀ 5 mm. — **St. 281.** ibid. 5 m. 30 m.w. (S. 100), 3^{45} pm. 120 min. 3 spec.: 1 ♂ ad. 6 mm, 2 ♀ 2—3 mm. — **St. 281.** ibid. 200 m. 40 m.w. (S. 100), 7^{50} pm. 120 min. 6 spec.: 1 ♂ ad. 4 mm, 5 ♀ 3—4 mm. — **St. 282.** 38°12′ N, 15°37′ E. 9-3-1911. 40 m.w. (S. 100), 2^{00} am., 60 min. 6 spec.: 1 ♂ jun. 4 mm, 5 ♀ 3—8 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 10^{45} pm., 180 min. 8 spec.: 2 ♂ jun. 2—4 mm, 3 ♀ 2 mm, 2 ♀ 3—4 mm, 1 ♀ 8 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 9^{00} pm., 90 min. 6 spec.: 1 ♂ jun. 2 mm, 3 ♀ 3 mm, 2 ♀ 4—8 mm. — **St. 282.** ibid. 40 m.w. (S. 100), 7^{15} pm., 90 min. 5 spec.: 1 ♂ jun. 2 mm, 3 ♀ 2—4 mm, 1 ♀ 9 mm. — **St. 283.** 38°12′ N, 15°37′ E. 13-3-1911. 40 m.w., 9^{45} pm., 180 min. 7 spec. 4 ♂ jun. 2—4 mm, 3 ♀ 4—6 mm. — **St. 283.** ibid. 40 m.w. (S. 100), 6^{30} pm., 180 min. 14 spec.: 3 ♂ 3—4 mm, 9 ♀ 2—5 mm, 2 ♀ 6—7 mm. — **St. 298.** 33°10′ N, 25°35′ E. 25-6-1911. 28 m.w. (S. 200), 11^{30} pm., 30 min. Abt. 175 spec.: abt. 25 ♂ jun. 3—4 mm, abt. 150 ♀ 2—4 mm, 4 ♀ 6 mm. — **St. 298.** ibid. 38 m.w. (S. 200), 11^{30} pm., 30 min. 63 spec.: 21 ♂ jun. 3—4mm, 42 ♀ 3—5 mm. — **St. 340.** 35°50′ N, 21°30′ E. 26-8-1911. 108 m.w. (S. 150), 9^{00} pm., 30 min. 2 ♀ 3—5 mm. — **St. 384.** 32°50′ N, 27°10′ E. 7-7-1911. 122 m.w. (S 150), 8^{30} pm., 30 min. 1 ♀ 6 mm. — **St. 385.** 35°10′ N, 18°10′ E. 9-11-1911 122 m.w. (S. 150), 8^{30} pm., 30 min. 24 spec.: 8 ♂ jun. 3—4 mm, 12 ♀ 3 mm, 4 ♀ 4 mm. — **St. 410.** 37°12′ N, 1°18′ W. 29-12-1911. 112 m.w. (S 150), 7^{00} pm. 1 ♀ 6 mm. — **St. 412.** 34°33′ N, 24°15′ E. 7-1-1912. 112 m.w. (S. 150). 6^{30} pm., 30 min. 2 spec. 2 mm: 1 ♂ jun., 1 ♀. — **St. 729.** 41°00′ N, 17°44′ E. 14-4-1913. 49 spec.: 4 ♂ ad. 5—6 mm., 10 ♂ jun. 4 mm, 24 ♀ 3—5 mm, 11 ♀ 8—10 mm. — **St. 730.** 38°26′ N, 13°37′ E. 16-4-1913. 7 spec.: 4 ♂ jun. 3 mm, 3 ♀ 3 mm. — **St. 731.** 37°19′ N, 1°31′ E. 19-4-1913. 2^{30} pm. 22 spec.: 6 ♂ jun. 4 mm, 13 ♀ 2—4 mm, 2 ♀ 6—7 mm, 1 ♀ 9 mm. — **St. 698.** 37°20′ N, 9°25′ E. 25-2-1913. 5^{00} am. 1 ♀ 7 mm.

Atlantic.

St. 65. 24-2-1909. 25 m.w., 5^{50} am., 30 min. 3 spec.: 1 ♂ ad. 6 mm, 2 ♀ 8—9 mm. — **St. 65.** ibid. 65 m.w., 6^{30} pm., 60 min. 3 ♀: 9, 12, 18 mm. — **St. 65.** ibid. 300 m.w., 7^{45} am., 120 min. 1 ♀ with ova 18 mm. — **St. 65.** ibid. 600 m.w., 10^{00} am., 120 min. 1 ♀ with embr. 23 mm. — **St. 65.** ibid. 1600 m.w., 0^{30} pm., 120 min. 3 ♀: 2 ♀ 9—14 mm, 1 ♀ with ova 19 mm. — **St. 66.** 25-2-1909. 1200 m.w., 8^{30} am., 120 min. 2 ♀ with ova 18 mm. — **St. 69.** 28-2-1909. 65 m.w., 10^{45} pm., 30 min. 15 spec.: 12 ♀ 4—7 mm, 2 ♀ 8 mm, 1 ♀ 10 mm. — **St. 69.** ibid. 300 m.w., 11^{40} pm., 30 min. 14 spec.: 7 ♀ 16—18 mm, 3 ♀ 19—22 mm, 4 ♀ with ova or embryos 18—22 mm. — **St. 69.** ibid. 600 m.w., 9^{00} pm., 60 min. 12 spec.: 3 ♂ ad. 6 mm, 1 ♂ jun. 4 mm, 8 ♀ 4—7 mm. — **St. 91.** 18-6-1910. 300 m.w., 6^{55} pm., 45 min. 1 ♀ 4 mm. — **St. 263.** 39°22′ N, 22°49′ W. 20-3-1911. 47 m.w. (S. 100), 7^{00} pm., 30 min. 2 ♂ jun. 4 mm. — **St. 264.** 38°14′ N, 24°35′ W. 19-3-1911. 47 m.w. (S. 100), 7^{00} pm., 30 min. 1 ♀ 4 mm. — **St. 266.** 40°47′ N, 21°10′ W. 20-3-1911. 47 m.w. (S. 100), 7^{00} pm., 30 min. 2 spec. 4 mm: 1 ♂ jun., 1 ♀. — **St. 376.** 34°41′ N, 16°14′ W. 22-7-1911. 15 m.w. (S. 200), 8^{15} pm., 30 min. 23 spec.: 8 ♂ jun. 3—4 mm, 15 ♀ 3—4 mm. — **St. 376.** ibid. 30 m.w. (S. 100), 8^{10} pm., 30 min. 11 spec.: 2 ♂ jun. 3 mm, 9 ♀ 3—5 mm. — **St. 377.** 31°23′ N, 18°18′ W. 23-7-1911. 15 m.w. (S. 200). 1 ♀ 4 mm. — **St. 382.** 34°12′ N, 16°24′ W. 23-10-1911. 22 m.w. (S. 100), 6^{05} pm., 30 min. 8 spec.: 3 ♂ jun. 4 mm, 5 ♀ 4 mm. — **St. 383.** 37°16′ N, 14°09′ W. 23-10-1911. 30 m.w. (S. 100). 6^{05} pm., 30 min. 12 spec.: 2 ♂ jun. 3 mm, 10 ♀ 4—6 mm. — **St. 398.** 36°48′ N, 14°22′ W. 26-10-1911. Surf. (S. 200), 12^{40} am., 30 min. 1 ♀ 4 mm. — **St. 399.** 34°23′ N, 15°31′ W. 26-10-1911. Surf. (S. 200), 9^{10} pm., 30 min. 3 spec.: 1 ♂ 3 mm, 2 ♀ 2 mm. — **St. 400.** 32°10′ N, 17°20′ W. 30-10-1911. Surf. (S. 200), 9^{35} pm., 30 min. 6 spec.: 3 ♂ jun. 3 mm, 3 ♀ 2—3 mm.

The material contains in all 2484 spec. (517 ♂, 1967 ♀) from 119 stations, 207 hauls; by far the greater number of specimens were taken in the Mediterranean.

A. Mediterranean.

	No. of stations	No. of hauls	No. of specimens ♂ ad.	♂ jun.	♀ without ova or embryos	♀ with ova	total	Average no. of spec. pr. haul
"Thor" Dec. 1908	3	4	—	—	5	—	5	1.3
Jan. 1909	6	10	—	1	23	—	24	2.4
Feb. —	14	18	1	6	79	—	86	4.8
June 1910	8	18	35	47	224	—	306	17.0
July —	26	55	62	125	986	1	1174	21.4
Aug. —	22	46	38	77	192	1	308	6.7
Sept. —	9	10	6	9	27	1	43	4.3
"Thor" total....	88	161	142	265	1536	3	1946	
other vessels	17	25	6	81	327	—	414	
total ...	105	186	148	346	1863	3	2360	

From the table it appears that there are 105 stations, 186 hauls, yielding in all 2360 spec. On an average, the summer hauls yielded much greater numbers than the winter hauls.

No other species was taken by the "Thor" Exp. at such a great number of stations and in so many hauls; *Phronima sedentaria* comes second to it.

Depth of the sea and occurrence.

m.	"Thor" 1908—10. No. of posit. st.	Total no. of st. of the "Thor"	Percentage of posit. st.
0— 500	17	67	22.1 %
> 500—1000	18	31	58.1 —
> 1000—2000	27	41	65.8 —
> 2000—3000	21	35	60.0 —
> 3000	5	10	50.0 —
total ...	88	184	

The species is thus almost only found at depths > 500 m. The 17 stations with depth < 500 m, have the following depths: 64, 75, > 75, 85 (3 st.), 98, 99, > 100, 105, 175—195, 200 (2 st.), 250 (2 st.), 350, 480 m.

As appears from Chart 21, the species is to be found over the whole of the Mediterranean; it even penetrates into the Adriatic, and is encountered as far as the mouth of the Dardanelles, but the stations are not evenly distributed in the two basins.

Chart 21. *Phrosina semilunata*. ● positive stations, + negative stations (>500 m, night, 10—250 mw). In the Mediterranean several stations lie so close to each other that it was impossible to note them all. In the Atlantic st. 263 264, 266, 376, 377, 382, 399, 400 lie outside the chart to the West.

	Stations with depth > 500 m.		
	Posit. st.	Total no. of st. of the "Thor"	Percentage of posit. st.
Western basin	56	83	67.5 %
Eastern —	15	34	44.1 %

Taking, as the table shows, only stations with a depth > 500 m there are thus $1^1/_2$ times as many per cent. of positive stations in the western as in the eastern basin.

Vertical occurrence. The species was taken in abt. 52 per cent. of all the night hauls ("Thor" 1908—10, depth > 500 m: 106 hauls out of 203), in abt. 38 per cent. of the day hauls (24 out of 64).

During the day, it was not taken nearer to the surface than with 50 m. w., but during the night almost exclusively with 10—35 m. w. (see the table). (According to Steuer (1913, fig. 14 p. 567) it only decreases very little in numbers with increasing depths).

m. w.	"Thor" 1908—10, > 500 m, night.		
	No. of spec. (normal hauls of 30 min.)	No. of posit. hauls	Average no. per normal haul (of 30 min.)
10— 35.....	abt. 1400	35	40
50—100.....	— 75	13	6
130—250.....	— 2	2	1

It may occur in large shoals, up to 450 spec. reckoned as normal hauls (of 30 min.); but as a rule only few specimens are taken at a time.

It is most numerous during the summer; at any rate there are the greatest number of shoals at that time of the year. Of the 32 winter hauls only 2 i. e.: 6.3 per cent. yielded more than 10 spec. (reckoned as normal hauls) *viz.* 11 and 24 spec. whereas 33 of the 129 summer hauls (1910) or 25.5 per cent. yielded 10 or more specimens per haul. True, the largest shoals during the summer are small, 10—50 spec.; the largest figures are the following (normal hauls): 69, 72, 74, 100, 120 (2 times), 170, 450. Curiously enough, there does not seem to be any essential difference between the number of individuals per haul in the two basins.

Size. In the Mediterranean, the "Thor" has taken about 4 times as many females as males: 494 ♂ (148 ad., 346 juv.), 1866 ♀.

♂ ad. The most common size is 5—6 mm, especially 6 mm; some few are 3—4 or 7 mm. Though the "Thor" took over 100 ♀ during the winter, there are only 1 ♂ ad. and 7 ♂ juv.; all the others were taken during the summer (June—Sept.); so it seems evident that ♂ ad. dies out during the autumn.

♂ jun. Most of them are 3—4 mm, a few 5 mm, one single specimen 7 mm.

♀ with ova or embryos. The "Thor" has only taken 3 spec. 21, 22, 27 mm in June—Sept. Lo Bianco (1904, p. 44) records that during the winter and spring, though but rarely, very large specimens may be found at Naples, but he does not say, whether they carry ova or not.

♀ without ova. 1863 specimens found both during winter and summer. The size varies from 2—30 mm, but most of the specimens are 2—10 mm.

Of the quite small specimens (2—4 mm) none have been found in Dec. and Jan.; in Feb. 16 were taken (of 79 ♀ in all) i. e. about 20 per cent., whereas in June—August they make about 50 per cent. of the entire number of females, which points towards their having been spawned at this time of the year; this agrees well with the fact that the only ovigerous females were taken during the summer. Only few females are over 8—10 mm, the numbers decreasing greatly with increasing size, but large specimens have been found, both winter and summer.

The propagation of the species is very difficult to explain from the material available. As ♂ ad. and quite small ♀ have, practically speaking, only been found during the summer, one would think that this was the season of propagation for the species; but in the Mediterranean, only 3 ♀ with ova or embryos were found, though all the larger females were carefully examined in this respect. A proportionally much greater quantity of females with ova or embryos was taken by the "Thor" in the Bay of Cadiz (see below) so that one might imagine that the small individuals were not born in the Mediterranean, but outside in the Atlantic; a further point in favour of this is, that all the ovigerous females in the Atlantic were taken at the end of February, so that in all probability it is the young from these ova which are to be found during summer in the Mediterranean.

B. Atlantic.

	stations	hauls	spec.
"Thor" Febr. 1910...	3	9	51
June — ...	1	1	1
"Thor" total	4	10	52
other vessels	10	11	72
total	14	21	124

The material from the Atlantic thus comprises 124 spec. (1 ♂ ad., 22 ♂ juv., 101 ♀) from 14 stations, 21 hauls.

The results agree quite well with those from the Mediterranean, with the exception that females with ova are proportionally much more numerous; of the 101 ♀, 9 have ova or embryos; the size is 18—23 mm and curiously enough, all were taken with at least 300 m. w. and only at the end of Feb. (in the Mediterranean June—Aug.). The species was only taken south of 40° N; the 18 negative stations (night 0—250 m. w., > 500 m) lie from the Bay of Cadiz to about 47° N.

Distribution.

Bovallius (Monograph) gives the distribution as Atlantic, Mediterranean, Indian Ocean and Pacific, without special localities.

1. Mediterranean. The enormous abundancy and large distribution of the species does not appear from the literature. In existing literature I have not been able to find more than the following localities. Nice (Risso). — Nice, Capri, Messina (Vosseler, in Lo Bianco 1902, 1903). — Lo Bianco (1903—04) regards it as belonging to Panteplankton (cf. Steuer 1913, fig. p. 567), and 1904, p. 44 he enumerates 12 spec. taken at day time (April) in 6 hauls, 500 or 1500 m. w. at Capri. Vosseler (in Lo Bianco 1903—04, p. 278) enumerates 106 spec. from 25 hauls (out of 43 hauls taken by the expedition in all). — Ragusa, 1 spec. 2.6 mm (Steuer 1911). — Adriatic, 0—900 m (Steuer 1913, p. 567). — Pesta (1920, p. 29) mentions 1 ♀ from the Adriatic, 42°11.3′ N, 17°47′ E, surf. — Our Zool. Museum has ancient specimens from Messina.

2. Atlantic. As will be shown by the following list the species is chiefly taken between 40° N and 7° S, but it is found as far as Cape of Good Hope. N. of 40° N only single specimens are found (see below), and off the European coasts it seems only to be found accidentally. — 50 miles W¾N of Tearaght, Co. Kerry (Ireland), 350 fms., Febr. 1906, surf., 1 ♀ (Tattersall 1906). — The Copenhagen Zoological Museum has, from ancient time, a very great material at all events partly determined by Bovallius (Monograph), from the following localities in the Atlantic (as to a material from the Indian Ocean, see below): 46° N, 20° W; 43°23′ N, 11°25′ W; 44° N, 43° W; 43° N, 44°16′ W; 42°50′ N, 46°10′ W; 42° N, 46° W; 40°30′ N, 34°30′ W; 39°30′ N, 50° W; 37°50′ N, 51° W; 34°10′ N, 42°10′ W; 36°22′ N, 40°48′ W; 31°30′ N, 21°16′ W; 31° N, 40° W; 30°34′ N, 30°50′ W; 30° N, 17°40′ W; 29° N, 20° W; 33°—28° N, 60°—64° W; 27°53′ N, 25°3′ W; 23°30′ N, 35°30′ W; 22° N, 20° W; 21° N, 36°30′ W; 20° N, 36° W; 19° N, 20°10′ W; 8° N, 24° W; 11°50′ S, 8°10′ W; 29° S, 18° W; 37°40′ S, 12° E; 38°16′ S, 15°10′ E.

Chevreux (1900, p. 147) enumerates 72 spec. (15 ♂, 57 ♀) from 11 st. within about the same area as the "Thor", but also farther to the west; most of the hauls have only given a single specimen each, but two hauls 22 and 24 spec. 8 of the stations lie between the Azores and New Foundland (36°6′ N, 29°18′ W.—42°50½′ N, 45°25′ W); 1 st. lies much farther to the north: 47°15¾′ N, 22°48¾′ W, 1 st. lies SW of Ireland 44°1½′ N, 15°31′ W, and 1 st. lies W of Ireland 47°17¼′ N, 11°58⅝′ W. Almost all the spec. are taken at the surface at night,

but some of them are found in the stomach of *Thynnus alalonga*.

The most important material known from existing literature is that taken by the German Plankton Expedition (Vosseler 1901), comprising 61 hauls, 172 spec. (18 ♂ ad., 54 ♂ jun., 15 ♀ ad., 85 ♀ jun.); only 3 hauls have given more than a single spec., *viz.* 14, 15 and 24 spec. The localities are as follows: The Gulf Stream 1 st. 41.1° N, 21.1° W, 0—350 m; Florida Current 4 st. 37.9° N, 59.1° W—41.6° N, 56.3° W, 0, 0—200 and 0—400 m; Sargasso Sea 16 st., from abt. 23.7° N, 36° W, and 30.8° N, 30.9° W, to 35° N, 62. 1° W, 0, 0—200 or 0—400 m; Northern Equatorial Current 15 st., from abt. 10.2° N, 22.2° W, to 28.3° N, 34.3° W, and besides 12° N, 40.3° W, and 20.4° N, 37.8° W, depths from the surface and to 0—400 m (0—500 m); Guinea Current 7 st., from 2.9° N, 18.4° W, to abt. 9.4° N, 43.5° W, 0—200 or 0—400 m, but 1 st. (2.9° N, 18.4° W) with closing net 1300—1500 m; Southern Equatorial Current 18 st. 1.7° N—6.8° S, 14°—35° W, (0) 0—200 or 0—400 m.

Gulf of Mexico, between Delta of Mississippi and Cedar Keys, 5 spec. (Pearse, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 378).

Stebbing ("Challenger") has the species from the following localities in the Atlantic (1 spec. from each st.): E.of Bermuda 35°18′ N, 51°42′ W, surf.; 18°8′ N, 30°5′ W, surf., night and 2°42′ S, 14°41′ W, surf., night. — Cape of Good Hope (Bate 1862; *Ph. nicetensis*). — Madeira, 3 spec., and near the Cape of Good Hope 35°14¼′ S, 15°11¾′ E, 2 ♀ (Stewart 1913).

3. Indian Ocean. The Copenhagen Zool. Museum possesses from ancient time a very great material of this species from the Atlantic (see above) and from the following localities in the Indian Ocean: 26°16′ S, 72° E; 35° S, 24° E; 35°30′ S, 29°30′ E; 35° S, 55° E; 36°36′ S, 27°40′ E; 36°50′ S, 50°30′ E; 37° S, 49°20′ E; 38°20′ S, 30° E; 38°29′ S, 29° E; 39°54′ S, 41°30′ E; 40°4′ S, 53°20′ E.

Walker (1909—10) mentions the species from the following localities: 4°16′ S, 71°53′ E, 1200 fms., 1 spec., 3^{30}—6^{30} pm.; ibid. 25 fms., 2^{10}—3^{10} am., 1 spec.; 1—2 miles NW of the passage into Salomon Atoll (S of Maldive), 1—180 fms., 4^{30}—5^{10} pm., 2 spec.; Mauritius, W of Black River, 25 fms., 1^{43}—2^{30} pm., 1 spec.; 8°16′ S, 51°26′ E, 900 fms., 11^{30} am.—1^{30} pm., 1 spec.; NNW of the entrance to Desroches (Amirante), 200 fms., afternoon, 5 spec.; about ibid., 300 fms., 8—9^{30} am., 1 spec. — The "Challenger" Exped. has taken 1 spec. 7°3′ N, 121°48′ E, night (Stebbing). — Buffalo River NW by N distant 21 miles off East London (S. Africa), 490 fms., 1 ♀ with ova (Barnard 1916).

4. Pacific. S of Japan 24°49′ N, 138°34′ E, night, 1 spec.; 26°29′ N, 137°57′ E, night, 1 spec.; 26 27′ S. 90° W, from the stomach of a shark ("*P. longispina*" Sp. Bate) (Stebbing, "Challenger"). — Without locality (Bovallius 1889).

3. Genus Euprimno (Guérin-Méneville) Bovall.

Euprimno Bovallius 1889, p. 397 (lit.). — *Primno* Stebbing 1904, p. 38 (lit.).

1. EUPRIMNO MACROPUS Guérin-Méneville (Chart 22).

**Primno macropa* Stebbing 1888, p. 1441, Pl. 178 (lit.). — *P. m.* Stebbing 1904, p. 38, textfigs. 1—2. — *Euprimno macropus* Bovallius 1889, p. 400, Pl. 17 figs. 23—40, Pl. 18 fig. 1—2. — *E. m.* Vosseler 1901, p. 87, Pl. 8 fig. 91.

Mediterranean.

St. 10. 15-12-1908. 1200 m.w., 9^{30} am., 60 min. 1 ♂ ad. 4.5 mm. — **St. 12.** 19-12-1908. 65 m.w., 1^{00} pm., 30 min. 3 ♀ 4—5 mm. — **St. 15.** 22-12-1908. 1400 m.w. (hour?), 60 min. 6 ♀ (4 with ova 5—6 mm), 4—6 mm. — **St. 34.** 23-1-1909. 25 m.w., 4^{35} am., 30 min. 1 ♀ 4 mm. — **St. 35.** 29-1-1909. 1600 m.w., 11^{25} am., 120 min. 3 ♀ 5 mm. — **St. 38.** 31-1-1909. 150 m.w., 30 min., 8^{20} pm. 1 ♀ 4 mm. — **St. 43.** 3-2-1909. 65 m.w., 30 min., 6^{15} am. 2 ♀ 5—7 mm. — **St. 46.** 7-2-1909. 300 m.w., 7^{30} pm., 30 min. 1 ♀ 5 mm. — **St. 46.** ibid. 600 m.w., 6^{25} pm., 30 min. 1 ♀ 6 mm. — **St. 47.** 10-2-1909. 300 m.w., 11^{05} pm., 30 min. 1 ♂ jun. 4 mm, 2 ♀ 4 mm. — **St. 52.** 18-2-1909. 300 m.w., 7^{25} am., 30 min. 8 spec.: 3 ♂ ad. 4 mm, 1 ♀ 6 mm, 4 ♀ 4 mm. — **St. 53.** 18-2-1909. 2600 m.w., 5^{15} pm., 90 min. 9 ♀ 4—5 mm (2 ♀ with ova 5 mm). — **St. 56.** 19-2-1909. 1900 m.w., 5^{30} am., 60 min. 7 spec.: 1 ♂ ad. 4 mm. 6 ♀ (1 with ova 5 mm) 5—6(7) mm. — **St. 58.** 20-2-1909, 100 m.w., 2^{00} pm., 30 min. 22 spec.: 3 ♂ ad. 4 mm, 2 ♂ jun. 3—4 mm, 17 ♀ (4 ♀ with ova 5—6 mm) 4—6 mm. — **St. 59.** 21-2-1909. 2^{30} am., 1200 m.w., 60 min. 23 ♀ (6 with ova 4—5 mm) 4—5 mm. — **St. 65.** 24-2-1909. 1600 m.w., 0^{30} pm., 120 min. 4 ♀ with ova 5—7 mm, 2 ♀ without ova 7 mm. — **St. 104.** 24-6-1910. 65 m.w., 6^{20} pm., 30 min. 4 ♀ 5 mm. — **St. 106.** 25-6-1910. 300 m.w., 1^{45} am., 30 min. 1 ♂ jun. 4 mm. — **St. 106.** ibid. 1200 m.w., 0^{20} am., 60 min. 38 spec.: 2 ♂ ad. 4—5 mm, 1 ♂ jun. 4 mm, 35 ♀ (9 with ova 5—6 mm) 4—6 mm. — **St. 107.** 25-6-1910. 65 m.w., 9^{50} am., 15 min. 9 spec.: 1 ♂ jun. 4 mm, 8 ♀ jun. 4—5 mm. — **St. 107.** ibid. 2000 m.w., 7^{30} am., 60 min. 42 spec.: 2 ♂ ad. 5—6 mm, 40 ♀ (8 with ova 5—6 mm) (4)5—6 mm. — **St. 108.** 26-6-1910. 2000 m.w., 0^{40} am., 60 min. 40 ♀ (4 with ova 5—6 mm) 4—6 mm. — **St. 112.** 27-6-1910. 300 m.w., 0^{15} am., 30 min. 3 spec.: 1 ♂ jun. 4 mm, 2 ♀ jun. 4—5 mm. — **St. 113.** 28-6-1910. 300 m.w., 3^{25} am., 30 min. 36 spec.: 2 ♂ ad. 4—5 mm, 34 ♀ (1 with ova 6 mm) 4—6 mm. — **St. 115.** 29-6-1910. 65 m.w., 1^{20} am., 15 min. 1 ♂ jun. 4 mm. — **St. 115.** ibid. 300 m.w., 11^{20} pm., 30 min. 1 ♀ 5 mm. — **St. 115.** ibid.

2000 m.w. 0^{30} am., 60 min. 7 spec.: 1 ♂ ad. 5 mm, 6 ♀ (2 ♀ with ova 5 mm) 5—6 mm. — **St. 116.** 29-6-1910. 300 m.w., 4^{05} pm., 30 min. 2 ♀ (1 with ova) 6 mm. — **St. 118.** 30-6-1910. 300 m.w., 5^{55} pm., 30 min. 1 ♀ 5 mm. — **St. 122.** 2-7-1910. 1200 m.w., 5^{30} pm., 60 min. 7 spec.: 3 ♂ ad. 5 mm, 1 ♀ with ova 6 mm, 3 ♀ without ova 4—5 mm. — **St. 126.** 10-7-1910. 300 m.w., 9^{30} pm., 30 min. 1 ♀ 5 mm. — **St. 129.** 12-7-1910. 1000 m.w., 4^{20} am., 60 min. 1 ♀ 5 mm. — **St. 129.** ibid. 3500 m.w., 3^{00} pm., 120 min. 1 ♀ with ova 5 mm. — **St. 131.** 13-7-1910. 300 m.w., 10^{35} am., 30 min. 4 spec.: 2 ♂ jun. 4—5 mm, 2 ♀ 4—5 mm. — **St. 132.** 14-7-1910. 300 m.w., 3^{45} am., 30 min. 5 ♀ 4—5 mm. — **St. 132.** ibid. 600 m.w., 4^{50} am., 30 min. 1 ♀ 6 mm. — **St. 133.** 14-7-1910. 300 m.w., 10^{15} pm., 30 min. 3 ♀ 4 mm. — **St. 133.** ibid. 600 m.w., 9^{20} m.w. 30 min. 13 spec.: 2 ♂ ad. 5 mm, 5 ♂ jun. 4 mm, 6 ♀ 4 mm. — **St. 134.** 15-7-1910. 300 m.w., 5^{40} am., 30 min. 16 spec.: 1 ♂ ad. 5 mm, 1 ♂ jun. 5 mm, 14 ♀ 4—5(6) mm. — **St. 137.** 19-7-1910. 250 m.w., 9^{05} am., 30 min. 6 ♀ (3)4—6 mm. — **St. 138.** 19-7-1910. 1000 m.w., 7^{40} pm., 60 min. 8 spec.: 1 ♂ ad. 5 mm, 1 ♂ jun. 5 mm, 6 ♀ (1 with ova) 5 mm. — **St. 143.** 23-7-1910. 300 m.w., 0^{30} am., 30 min. 1 ♀ 4 mm. — **St. 143.** ibid. 1000 m.w., 2^{00} am., 60 min. 16 spec.: 2 ♂ jun. 4 mm, 14 ♀ 4—5 mm. — **St. 144.** 24-7-1910. 4000 m.w., 6^{20} am., 60 min. 1 ♀ 5 mm. — **St. 147.** 26-7-1910. 1000 m.w., 1^{10} am., 60 min. 1 ♀ 5 mm. — **St. 152.** 28-7-1910. 1000 m.w., 0^{30} am., 60 min. 1 ♀ 4 mm. — **St. 154.** 29-7-1910. 300 m.w. 4^{30} am., 30 min. 1 ♀ 4 mm. — **St. 156.** 30-7-1910. 300 m.w., 3^{50} am., 30 min. 1 ♀ with ova 5 mm. — **St. 156.** ibid. 600 m.w., 3^{00} am., 30 min. 1 ♀ 5 mm. — **St. 156.** ibid. 1000 m.w., 0^{40} am., 60 min. 1 ♀ 4 mm. — **St. 158.** 31-7-1910. 300 m.w., 7^{30} am., 30 min. 95 spec.: 9 ♂ jun. 4 mm, 86 ♀ (14 with ova or embryos 5—6 mm) 5—6 mm. — **St. 160.** 1-8-1910. 300 m.w., 2^{45} am., 30 min. 6 spec.: 2 ♂ jun. 4 mm, 6 ♀ 4—6 mm. — **St. 160.** ibid. 1000 m.w. 3^{35} am., 60 min. 31 spec.: 8 ♂ jun. 4—5 mm, 23 ♀ (1 with ova 6 mm) 4—5(6) mm. — **St. 160.** ibid. 4000 m.w., 3^{30} pm., 60 min. 20 spec.: 3 ♂ ad. 5 mm, 17 ♀ (7 with ova 5—6 mm) 5—6 mm. — **St. 163.** 3-8-1910. 25 m.w., 1^{35} am., 15 min. 1 ♀ 5 mm. — **St. 163.** ibid. 300 m.w., 1^{05} am., 15 min. 6 ♀ 5—6 mm. — **St. 163.** ibid. 1000 m.w., 0^{05} am., 30 min. 21 spec.: 2 ♂ ad. 5 mm, 1 ♂ jun. 4 mm, 18 ♀ (3 ♀ with ova or embr. 5—6 mm) 5—6 mm. — **St. 178.** 12-8-1910. 65 m.w., 0^{20} pm., 15 min. 12 spec.: 2 ♂ jun. 4 mm, 10 ♀ (1 with ova 5 mm) 3—5 mm. — **St. 181.** 13-8-1910. 300 m.w., 1^{25} pm., 20 min. 9 spec.: 1 ♂ ad. 5 mm, 3 ♀ with ova 5 mm, 5 ♀ 6 mm. — **St. 182.** 13-8-1910. 600 m.w., 11^{40} pm., 30 min. 12 ♀ (5 with ova) 5—6 mm. — **St. 183.** 16-8-1910. 300 m.w., 4^{45} pm., 15 min. 11 spec.: 1 ♂ ad. 5 mm, 9 ♀ 4—5 mm, 1 ♀ 7 mm. — **St. 192.** 20-8-1910. 300 m.w. 10^{10} pm., 15 min. 3 spec.: 2 ♀ 6 mm, 1 ♀ 3 mm. — **St. 192.** ibid. 600 m.w., 10^{50} pm., 30 min. 3 spec.: 2 ♂ jun. 3—4 mm, 1 ♀ 5 mm. — **St. 194.** 21-8-1910. 1200 m.w., 6^{00} am., 30 min. 1 ♀ with ova 4 mm. — **St. 195.** 21-8-1910. 65 m.w., 6^{50} pm., 15 min. 1 ♀ 4 mm. — **St. 199.** 25-8-1910. 1000 m.w., 10^{10} pm., 30 min. 2 ♀ 5 mm. — **St. 202.** 26-8-1910. 300 m.w., 5^{05} pm., 15 min. 3 spec.: 1 ♀ with ova 6 mm, 2 ♀ 5 mm. — **St. 206.** 28-8-1910. 1000 m.w., 1^{40} am., 45 min. 2 spec.: 1 ♂ jun. 4 mm, 1 ♀ 4 mm. — **St. 206.** ibid. 2000 m.w., 3^{05} am., 45 min. 5 spec.: 1 ♂ jun. 4 mm, 4 ♀ (2 with ova 4—5 mm) 4—5 mm. — **St. 209.** 29-8-1910. 1000 m.w., 6^{00} am., 45 min. 3 spec.: 1 ♂ jun. 4 mm, 2 ♀ 5 mm. — **St. 209.** ibid. 100 m.w., 3^{45} pm., 20 min. 2 ♀ 4 mm. — **St. 209.** ibid. 150 m.w., 4^{25} pm., 20 min. 1 ♀ 5 mm. — **St. 209.** ibid. 2000 m.w., 7^{25} am., 45 min. 1 ♂ ad. 5 mm. — **St. 210.** 30-8-1910. 600 m.w., 3^{35} am., 30 min. 2 ♀ 4—5 mm. —**St. 217.** 1-9-1910. 300 m.w., 1^{40} pm., 30 min. 5 ♀ (1 with ova 6 mm) 4—6 mm. — **St. 282.** 38°12′ N, 15°37′ E. 9-3-1911. 40 m.w., 2^{00} am., 60 min. 1 ♀ with ova 6 mm, 1 ♀ 3 mm. —**St. 282.** ibid. 40 m.w., 5^{30} pm., 90 min. 1 ♀ 4 mm. — **St 729** 41°00′ N, 17°44′ E. 14-4-1913. 11^{30} am. 66 spec.: 12 ♂ jun. 4 mm, 4 ♀ with ova 5—6 mm, 49 ♀ 4—5 mm, 1 ♀ 6 mm. — **St. 731.** 37°19′ N, 1°31′ E. 19-4-1913. 2^{30} pm. 1 ♀ 6 mm, 2 ♀ 4 mm.

Atlantic.

St. 65. 24-2-1909. 25 m.w., 5^{50} am., 30 min. 1 ♀ 4 mm. — **St. 65.** ibid. 600 m.w., 10^{00} am.(?), 120 min. 3 ♀ 5—7 mm. — **St. 87.** 17-6-1910. 65 m.w., 4^{40} pm., 15 min. 8 ♀ (1 with ova) 6 mm. — **St. 87.** ibid. 300 m.w., 4^{00} pm., 30 min. 2 ♀ 5 mm. — **St. 89.** 18-6-1910. 1000 m.w., 4^{10} am., 30 min. 2 ♀ 5 mm. — **St 91** 18-6-1910. 300 m.w., 6^{55} pm., 45 min. 1 ♂ jun. 4 mm, 1 ♀ 7 mm. — **St. 91.** ibid. 1600 m.w., 5^{25} pm., 60 min. 27 ♀ (4)5—6 mm. — **St. 95.** 23-6-1910. 300 m.w., 5^{10} am., 30 min. 1 ♀ 5 mm.

The material contains 742 spec. (88 ♂, 654 ♀) from 63 stations, 86 hauls, and by far the greatest number of specimens was taken in the Mediterranean.

A. Mediterranean.

	No. of stations	No. of hauls	No. of spec.
"Thor" Dec. 1908....	3	3	10
Jan. 1909....	3	3	5
Febr. —	9	10	82
June 1910 —	9	13	184
July —	16	22	177
Aug. —	14	23	161
Sept. —	1	1	5
"Thor" total	55	75	624
other vessels	3	4	73
total...	58	79	697

The 697 specimens from the Mediterranean were 88 ♂, 609 ♀.

Depths of the sea and occurrence (chart 22).

Depths in m.	No of posit. st. ("Thor" 1908—10)	Total no. of st. of the "Thor" (1908—10)	Percentage of posit st.
0— 500	10	67	15 %
> 500—1000	10	31	32.3 —
> 1000—2000	16	41	39 —
> 2000—3000	15	35	42.9 —
> 3000	4	10	40 —
total...	55	184	

From this it appears that the species has its chief distribution in depths > 1000 m; but it is also very abundant at depths from >500—1000 m; only exceptionally is it to be found at depths < 500 m (the 10 stations with this depth vary between 68 and 480 m).

The species is distributed over both basins of the Mediterranean, and has even been encountered in the southern regions of the Adriatic and at the mouth of the Dardanelles, but it is more frequent in the western than in the eastern basin. The "Thor" 1908—10 has in the western basin 39 positive stations, in the eastern 16 positive stations; considering only stations with a depth > 500 m, the figures are 34 and 11 respectively. In the western basin there are 34 negative stations (night, > 500 m) in the eastern 16 negative stations. In the western basin there are thus 34 positive stations out of 68 in all i. e. 50 per cent.; in the eastern 11 out of 27 i. e. 40.7 per cent.; there are thus $1^1/_4$ times as many positive stations in the western as in the eastern basin.

Chart 22. *Euprimno macropus*. ● positive st., + negative st. (night, > 500 m, 0-4000 mw). In the Mediterranean some of the stations lie so close to each other that it was impossible to note them all.

Vertical occurrence.

m. w.	No. of hauls "Thor" 1908—10, >500 m. Night: No. of posit. hauls	Night: total no. of hauls	Night: percentage of posit. hauls	Day: No. of posit. hauls	Day: total no. of hauls	Day: percentage of posit. hauls
10— 35	2	67	3%	—	5	0
50— 100	2	35	5.7	3	10	30
130— 250	—	6	—	1	3	33.3
300— 400	14	49	28.6	7	22	31.8
500— 800	5	13	38.6	—	5	—
1000—1200	14	22	63.6	2	9	22.2
1400—1800	1	5	20	2	3	66.7
>1800	3	6	50	6	7	85.7
total ..	41	203		21	64	

From the table it will be seen that the species, curiously enough, lives considerably deeper down than the two other species of this family: at night particularly in the intermediate water-layers (300—1200 m. w.) and only very rarely quite near the surface; during the day, on the other hand, from 50 m. w. down to the very greatest depths. That the number increases with the depth during the night has already been shown by Steuer (1913, p. 567, fig. 14), who points out that it increases in numbers, at any rate as far as 800 m below the surface. This does not appear so clearly from the collections of the "Thor", though these point in the same direction; but this is undoubtedly due to the fact that the species occurs, sometimes in shoals, sometimes more sporadically. The shoals may occur both in winter and summer.

Size and propagation. The ♀ is as a rule a little larger than the ♂, the most ordinary size for the grown ♂ being 4—5 m, for ♀ 5—6 mm. ♀ with ova were taken in Dec., Feb., March, April, June, July, Aug., Sept. ♀ with embryos in July—August, so that the species propagates all the year round. In proportion to the ovigerous ♀ very few have embryos whence it seems that the embryos leave the mother very soon after having been hatched. ♀ with ova and embryos have only once (winter, day time) been taken with 100 m. w. otherwise with 300—4000 m. w. particularly 300 m. w. or at the extreme limit of the fairly frequent occurrence of the species.

B. Atlantic.

There are 45 spec. from 5 stations, 7 hauls. The material is too small to make the basis of biological results.

Distribution.

1. Mediterranean. From Lo Bianco 1902 and 1903 (1904) it is panteplanktonic (50—1200 m) and very common at Naples in spring at the surface. 1904 Lo

Bianco enumerates (p. 43) 6 hauls during the day at Naples (April): 4 hauls 1500 m. w. have given 9 spec., 2 hauls 500 m. w.: 4 spec. — Vosseler (in Lo Bianco 1903—04, p. 278) enumerates abt. 135 spec. from 22 day hauls (Febr. 6 to May 10); 18 hauls are from Naples, 2 hauls between Capo Corso and Monaco, 1 at Salina (Eolian Islands) and 1 at Stromboli. The depths of the sea are (600) 1000—2600 m, the lengths of the wire commonly 500—2500 m; but there are 6 hauls with closing net with the following length of wire in metres: 100, 200, 300, 1000, 1200, 1200. — Adria 0—800 m (Steuer 1913).

2. Atlantic. Very common between abt. 40° N and abt. 8° S, but is also found both to the north and to the south of these limits. SW Ireland 2 st., 199—> 1000 fms., 2 spec. (Tattersall 1906) — 47°38¼′ N, 22° 13⅔′ W, 1300 m, and 47°42⅔′ N, 19°30¼′ W, 781 m, 3 spec. (Chevreux, "Hirondelle" 1900). — Bay of Biscay, 5 hauls 0—100 fms., 5 spec. jun. (Stebbing l. c. 1904). — W. of Bay of Cadiz ("Thor", see above)

The German Plankton-Exped. (Vosseler 1901) had 295 spec., 91 stations from the following parts of the Atlantic. The Gulf Stream 1 st. 39° N, 23.5 W, 0—37 m. Labrador Current 1 st. 42.4° N, 55.7° W, 0—750 m. Florida Current 8 st. 41.6° N, 56.3° W, to 37.9° N, 59.1° W, surf., 0—200 or 0—400 m, and 1 haul with closing net 400—600 m. Sargasso Sea 30 stations 37.1° N, 59.9° W to 30.8° N, 51.1° W, and 30.9° N, 50° W to 29.8° N, 36.8° W, 0—200 or 0—400 (0—700) m, 1 haul with closing net 800—1000 m (30.3° N, 37.9° W); furthermore 25.6° N, 34.9° W, and 30.8° N, 30.9° W. N. Equatorial Current 13 st. 28.9° N, 35° W to 10.2° N, 26.6° W, and 12° N, 40.3° W; 0—200 or 0—400 (500) m. Guinea Current 8 st. 7.9° N, 21.4° W to 2.9° N, 18.4° W; besides 6.9° N, 43.3° W and 9.4° N, 41.9° W; 0—200 or 0—400 m. S. Equatorial Current 30 stations 17° N, 17.3° W to 5.1° S, 4.1° W, and 6.8° S, 14.2° W to 7.8° S, 17.3° W and to 1.8° S, 38.1° W, 0—(100) 200 m or 0—400 (600) m, but 1 haul with closing net (0.1° N, 15.2° W), 500—700 m. — 30°34′ N, 30°50′ W (specimens in the Copenhagen Zool. Mus.). — Tristan da Cunha 36°27½° S, 8°20′ W, 1 ♀ (Stewart 1913).

3. Indian Ocean. The Copenhagen Zool. Mus. has specimens from 38°30′ S, 30° E, and 32°15′—33° S, 58°—58½° E. — 4°16′ S, 71°53′ E, 2082 fms., 100 fms.; 1—2 miles NW of passage into Salomon Atoll (S of Maldive), 1—180 fms.; Mauritius, W of Black River, 25 and 50 fms.; 3 miles NW of entrance into Desroches Atoll (Amirante), 200, 250 and 300 fms. [Walker 1909 (1910), totally 10 spec.]

4. Pacific. 36°32′ S, 132°52′ W, surf., 57.8° F, 1 ♀ with embr. (Stebbing, "Challenger").

III. LIST OF LITERATURE UP TO 1918

(including a few papers of later date).

A complete list of literature older than 1887, see Stebbing, Amphip. "Challenger" 1888, p. 1—600, Appendix p. 1617—56.
For literature including only one single species, genus or family, see the species etc. in question.
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REPORT ON THE DANISH OCEANOGRAPHICAL EXPEDITIONS 1908 10
TO THE MEDITERRANEAN AND ADJACENT SEAS
Vol. II. Biology.

H. 1.

Medusæ

By

P. L. Kramp.

With 40 figures and 12 charts in the text.

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I. THE SPECIES RECORDED.

ANTHOMEDUSÆ.

1. KÖLLIKERIA FASCICULATA (Péron & Lesueur).

(Fig. 1 and Chart I).

Melicerta fasciculata Péron & Lesueur 1809, p. 353.
Lizzia köllikeri Gegenbaur 1856. Versuch eines Systems der Medusen, p. 225, Taf. 7, fig. 5—9.
Köllikeria fasciculata L. Agassiz 1862. Contr. Nat. Hist. U. S. Vol. 4, p. 345.
Rathkea fasciculata Haeckel 1879, System der Medusen, p. 97.

Material[1].

Mediterranean, Keferstein & Ehlers, 1 specimen, Haeckel determ.
Stat. 89. Lat. 36°28′ N., Long. 8°22′ W. 18. VI. 1910.
Y. 1000 m wire. — 1 specimen.
Stat. 99. Lat. 36°02′ N., Long. 5°16′ W. 24. VI. 1910.
Y. 300 m wire. 9 specimens, height of the bell 5—7 mm.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 1 specimen.
Y. 300 m wire, 12 specimens, height 5—7 mm.
Y. 1200 m wire, 2 large specimens.
Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 300 m wire, 2 specimens.
Stat. 152. Lat. 33°11′ N., Long. 21°44′ E. 27. VII. 1910.
Y. 300 m wire, 1 specimen.
Stat. 154. Lat. 32°10′ N., Long. 24°46′ E. 29. VII. 1910.
Y. 300 m wire, 1 specimen, height 6 mm.

Further Distribution.

Nice, Naples, Messina (Carus 1884, p. 25, Lobianco 1888, p. 388), Villefranche (Metschnikoff 1886, p. 237), Monaco (Maas 1904 a, p. 10 & 64—65).

Maas (1904 a, p. 11) indicates the possibility of this species being identic with *Rathkea blumenbachii* from the Black Sea and *R. octopunctata* from the Atlantic Ocean, at any rate he will not separate them generically. Also Mayer (1910, p. 179) refers *Köllikeria fasciculata* to the genus *Rathkea*, because the tentacles are grouped in 8 clusters. This is, however, an artificial character. The shape of the oral tentacles separates *Köllikeria* from *Rathkea*, according to the definition of the latter, given by Hartlaub (1911, p. 228). Hartlaub is undoubtedly right in ascribing great systematic importance to the shape of the mouth and the position of the oral tentacles in *Margelidæ*.

Köllikeria fasciculata is common at the surface in the Gulf of Naples during the winter, but from the beginning of the summer it belongs to the pelagic animals of the deep-sea (Lobianco 1888, p. 388).

The "Thor" failed to find the species during the winter cruise, but found it in several localities in June and July 1910, mostly in intermediate and deep water layers.

The investigations of the "Thor" have increased the known area of

Fig. 1. *Köllikeria fasciculata* (Péron & Lesueur). — From A. G. Mayer 1910.

[1] Y = Petersen's Young-fish trawl, 200 cm in diameter at opening. — For description of this and other implements, see Johs. Schmidt: Introduction, in vol. I of this Report.

distribution of this species to a considerable degree. It was found for the first time in the eastern basin of the Mediterranean (stat. 152 and 154, near the coast of Cyrenaïca, Tripoli), and in the Alboran Sea (stat. 99, 106, and 108). It was even found outside of the Mediterranean, *viz.* at stat. 89 in the Cadiz Bay in a haul with 1000 m wire out, *i. e.* in the outflowing Mediterranean water. It is possible, therefore, that the species may prove, in future, to have a wider distribution in the Atlantic.

Fig. 2. *Oceania armata* Kölliker. — From A. G. Mayer 1910.

2. OCEANIA ARMATA Kölliker.

(Fig. 2 and Chart II).

Oceania armata Kölliker 1853, Zeitschr. wiss. Zool., Bd., IV, p. 323.

Oceania flavidula Gegenbaur 1856, Vers. Syst. Med., p. 223, Taf. VII, Fig. 4.

Turritopsis armata Haeckel 1879, p. 65.

Callitiara polyophthalma do., p. 67, Taf. III, fig. 1—5.

Turritopsis armata Carus 1884, p. 23.

Oceania armata Mayer 1910, p. 147, figs. 79—81.

Mayer (1910, p. 146—147) reintroduced the generic name *Oceania* for this species. I quite agree with Hartlaub (1911, p. 202) in the hope that this old genus "damit endlich einmal fixiert bliebe".

Material.

Stat. 147. Lat. 31°35′ N., Long. 19°02′ E. 25. VII. 1910.
Y. 300 m wire, 2 specimens, 5 mm high.
Stat. 152. Lat. 33°11′ N. Long. 21°44′ E. 27. VII. 1910.
Y. 300 m wire, 1 specimen, 5 mm high.
Stat. 154. Lat, 32°10′ N., Long. 24°46′ E. 27. VII. 1910.
Y. 300 m wire, 1 specimen, 3 mm high.
Stat. 156. Lat. 32°24′ N., Long. 26°51′ E. 30. VII. 1910.
Y. 300 m wire, 1 specimen, 3 mm high.
- 600 - — 2 — 4 - —
- 1000 - — 2 — 5 - —

Stat. 158. Lat. 34°23′ N., Long. 27°57′ E. 31. VII. 1910.
Y. 300 m wire, 24 specimens, 3—4 mm high.
Stat. 160. Lat, 35°59′ N., Long. 28°14′ E. 1. VIII. 1910.
Y. 300 m wire, 5 specimens, $2^1/_2$—5 mm high.
- 1000 - — 9 — 3 —4 - —
Stat. 163. Lat. 37°52′ N., Long. 26°22′ E. 3. VIII. 1910.
Y. 25 m wire, 1 specimen, $2^1/_2$ mm high.
- 300 - — 8 — 3—4 - —
- 1000 - — 2 — $2^1/_2$ - —

Further Distribution (see Chart II, p. 7).

Messina (Carus 1884, p. 23; Metschnikoff 1886, p. 239); Naples and Villefranche (Metschnikoff 1886, p. 239), Canary Islands (Haeckel 1879, p. 67, *Callitiara polyophthalma*).

Before 1886 (Metschnikoff) this species was only recorded from Messina; Metschnikoff found it at Naples and Villefranche, so that it is widely distributed in the western basin of the Mediterranean. The "Thor" on the other hand, only found it in the eastern basin, *viz.* off the coast of Tripoli, in the Levant, and in the Ægean Sea. It inhabits the intermediate water layers and only occasionally rises towards the surface.

3. MERGA LOBIANCI Hartlaub.

(Fig. 3 and Chart I).

Pandea sp. Lobianco 1903, p. 217, tav. 7, fig. 1.

i. p. *Pandea violacea* Mayer 1910, p. 119, fig. 64.

Mergintha lobianci Hartlaub 1911, pp. 242 & 250.

This species was described and figured by LOBIANCO (1903, p. 217) from two specimens from the Gulf of Naples. MAYER (1910, p. 119) who has examined the two type-specimens identifies this Mediterranean form with "*Pandea violacea*" AGASSIZ & MAYER from the Tortugas, Florida. I quite agree with HARTLAUB that the presence of complexly folded lips in the Mediterranean form separates it from *violacea* as a proper species (the lips are folded in all specimens examined; *cfr.* HARTLAUB p. 250). As the gonads have

Chart I. ● Finds of *Kōllikeria fasciculata* (Pér. & Les.), O occurrence according to the literature.
▲ Finds of *Merga lobianci* Hartlaub, △ occurrence according to the literature.

Fig. 3. *Merga lobianci* (Hartlaub). From A. G. Mayer 1910 (the tips of the tentacles are removed).

a smooth surface neither *violacea* nor *lobianci* can belong to the genus *Pandea*; so far I agree with Hartlaub. On the other hand, I cannot ascribe sufficient importance to the occurrence of folded lips in *lobianci* for generically separating this species from *violacea*. I should prefer referring both of them to the genus *Merga*, as defined by HARTLAUB, and with *Merga violacea* (AGASSIZ & MAYER) as the type species.

Material.

Stat. 142. Lat. 35°44′ N., Long. 15°07′ E. 22. VII. 1910.
Y. 25 m wire, 1 specimen, 6 mm high.
Stat. 147. Lat. 31°35′ N., Long. 19°02′ E. 25. VII. 1910.
Y. 25 m wire, 1 specimen, 7 mm high.
Stat. 184. Lat. 38°10′ N., Long. 22°33′ E. 17. VIII. 1910.
Y. 10 m wire, 1 specimen, 8 mm high.
- 65 - — 2 — 8 - —
Stat. 200. Lat. 39°18′ N., Long. 10°11′ E. 26. VIII. 1910.
Y. 25 m wire, 4 specimens, 6—7 mm high.

LOBIANCO's original specimens were 11 mm high, so that the present specimens are not quite grown up.

Further Distribution.

The original specimens were found near Capri (Gulf of Naples) in great depths (500—600 fms.). A young medusa, found near Trieste in March by NEPPI & STIASNY (1913, p. 20, Taf. I, Fig. 9, *Pandea* sp.) may possibly belong to this species, but the specimen is too young (1.8 mm high) for definite identification.

Merga lobianci seems to be widely distributed in the Mediterranean (see Chart I). The "Thor" found it in the Gulf of Corinth (stat. 184), in the Gulf of Sidra, south of Sicily, and east of Sardinia. LOBIANCO found the species in deep water (500—600 fms.), but the 9 specimens, found by the "Thor", were all taken in the upper strata, partly very near the surface (10—65 m wire out).

4. TIARANNA ROTUNDA (Quoy & Gaimard).

(Fig. 4 and Chart IV).

Dianœa rotunda Quoy et Gaimard 1827, p. 181, pl. 6 A, figs. 1, 2.
Tiara rotunda Haeckel 1879, p. 57.

Tiara rotunda Maas 1910, p. 8.
Tiaranna rotunda Hartlaub 1913, p. 266.
Rotundula brochii Hartlaub 1917, p. 411, Fig. 341—343.
Tiaranna rotunda Kramp 1919, "Ingolf" Exped., p. 5—6, textfigs. 1—2.
Tiaranna rotunda Kramp 1920 a, "Michael Sars" Exped. 1910, p. 6, Pl. I, figs. 2—4.

In the paper quoted above (KRAMP 1920 a) I gave a new description and new figures (very badly reproduced, indeed) of this interesting species, and in a previous paper (KRAMP, 1919) I mentioned the peculiar "dwarf tentacles", which I compared with the "cordyli" of the *Laodiceidæ*. — Later on a specimen from the Trondhjem Fjord, Norway, has enabled me to state that the "*Rotundula brochii*" Hartlaub is identical with *Tiaranna rotunda* Quoy & Gaimard.

Material.

Stat. 99. Lat. 36°02′ N., Long. 5°16′ W. 24. VI. 1910.
Y. 300 m wire, 2 specimens, diam. ca. 8 mm.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 1200 m wire, 7 specimens, diam. 5—8 mm.

This species may grow much larger. It would have been interesting to examine the present young specimens somewhat more thoroughly, but they are too badly preserved for morphological investigation.

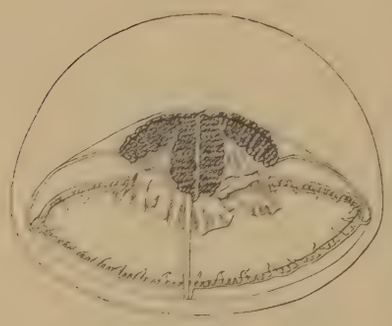


Fig. 4. *Tiaranna rotunda* (Quoy & Gaimard). — From Kramp 1920 a.

Distribution (see Chart IV, p. 13).

The Strait of Gibraltar is the classical locality of this species. The "Michael Sars" found it in the Alboran Sea about 40 miles inside the Strait of Gibraltar. stat. 106 of the "Thor" is still further eastwards in the Mediterranean (eastern part of the Alboran Sea). — When I wrote the above mentioned paper ("Michael Sars", KRAMP 1920 a) the only find of *Tiaranna rotunda* outside the Mediterranean was a young specimen from the northern part of the North Sea, mentioned (and figured) by HARTLAUB (1913, p. 266—268, fig. 219). To this may now be added the "*Rotundula brochii*" Hartlaub from the Trondhjemsfjord, Norway, and several specimens found by DAMAS in various localities at the west coast of Norway. It also occurs in the deep channel of the Skagerrak, where I have found several specimens at a depth of 650 m.

5. LEUCKARTIARA OCTONA (Fleming).

(Fig. 5 and Chart II).

List of synonyms, see HARTLAUB 1913, p. 285.

Material.

Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 5 specimens, 3—7 mm high.
- 1200 - 1 - - 7 -
Stat. 107. Lat. 36°13′ N., Long. 1°28′ W. 25. VI. 1910.
Y. 300 m wire, 1 specimen, 6 mm high.
Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 65 m wire, 5 specimens, 3—8 mm high.
Stat. 176. Lat. 40°45′ N., Long. 27°43′ E. 12. VIII. 1910.
Y. 65 m wire, 4 specimens, 5—6 mm high.

Further Distribution.

On account of the frequent confounding of *Leuckartiara octona* (Fleming), *Neoturris pileata* (Forskål), and some other species of *Tiaridæ*, it is difficult to give an exact statement of the geographical

distribution of these species. The following record of the distribution of *Leuckartiara octona* is derived partly from HARTLAUB (1914, p. 289 ff.), partly from material in the Zoological Museum of Copenhagen, and from other material examined by me.

Mediterranean: Nice (HAECKEL 1879, p. 58, *Tiara pileata*). Villefranche (HARTLAUB). Harbour of Monaco, May 1901; between Monaco and Corsica, April 10th 1894, surface; south coast of Sicily, Aug. 16th 1893, surface (MAAS 1904 a, p. 15, *Tiara pileata*). Naples (HARTLAUB). Further the hydroid, *Perigonimus repens*, has been observed in the Adriatic Sea.

Eastern Atlantic area: Off the coasts of Great Britain and Ireland, in the North Sea, the Skagerrak, along the west coast of Norway as far north as Lofoten; between Scotland and Iceland and at the northwest coast of Iceland.

Western Atlantic area: Along the coast of North America from Newport to Nain in Labrador.

Indo-Pacific region: Widely distributed.

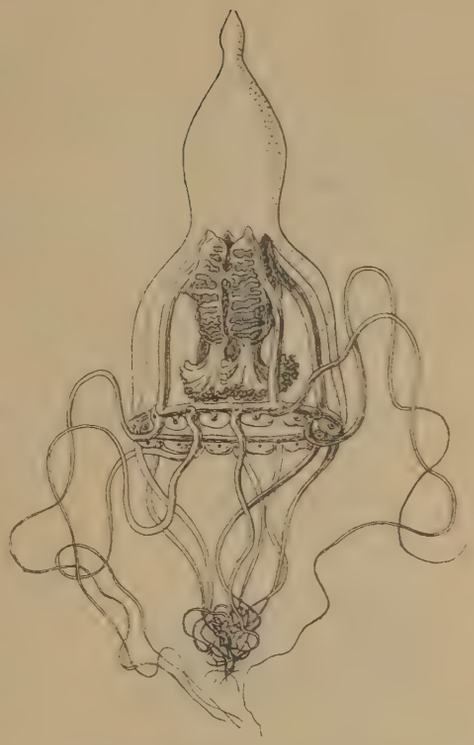


Fig. 5. *Leuckartiara octona* (Fleming). — After Haeckel 1879 (from Nord. Plankton).

Leuckartiara octona belongs to the upper water layers of the coastal areas. Owing to the fairly long duration of its pelagical life, it may, in certain areas, occasionally be driven rather far out at sea. It may also, now and then, be found in intermediate water layers, 100—200 m below the surface, but the find of a specimen at stat. 106 in a haul with 1200 m wire out is an exceptional case; it may have been captured during the hauling up of the net through the upper strata.

In the western basin of the Mediterranean the species was only found by the "Thor" at a few stations in the Alboran Sea (in June). This may be due to the neritic habits of the medusa. Till now the medusa was never found in the eastern basin, though it was to be expected there, as the hydroid occurs in the Adriatic Sea. The "Thor" found 4 specimens in the Sea of Marmora in August.

Chart II. ● Finds of *Oceania armata* Köll., O occurrence according to the literature.
▲ Finds of *Leuckartiara octona* (Flem.), △ occurrence in the Mediterranean, according to the literature.

6. NEOTURRIS PILEATA

(Forskål).

(Fig. 6).

Synonyms, see Hartlaub 1914 (Nordisches Plankton), p. 326 ff.

Material.

Stat. 104. Lat. 36°37′ N., Long. 2°04′ W. 24. VI. 1910.
Y. 65 m wire, 1 specimen, 10 mm high.

Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 1 specimen, 6 mm high.

Stat. 107. Lat. 36°13′ N., Long. 1°28′ W. 25. VI. 1910.
Y. 65 m wire, 2 specimens, 6—12 mm high.

Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 25 m wire, 1 specimen, 6 mm high.

Further Distribution.

Mediterranean: Harbour of Monaco, surface, May 1901, specimens about 30 mm high (*Turris coeca*, Maas 1904 a, p. 17, Pl. I, fig. 5). — Villefranche (*N. pileata*, Hartlaub 1914, p. 328). — Genoa (*Dianea pileata*, Verany 1846, sec. Hartlaub). — Nice (Risso, Leuckart, sec. Hartlaub). — Naples, February and March (Hartlaub 1914, p. 328). — Trieste: from November during the winter until April, mature in February and May (*Tiara pileata*, Graeffe 1884, p. 23); December to March, up to 35 mm high (*Turris coeca*, Neppi & Stiasny 1913, p. 19). — Coast of Dalmatia, July, small specimens (*Turris coeca*, Neppi 1912, p. 720).

Outside the Mediterranean: Off the British coasts, between Scotland and Iceland, and off the southern coasts of Iceland; in the North Sea, whence it is occasionally drifted into the Kattegat; along the west coast of Norway as far north as Lat. 64° N. — It is not restricted to the coastal areas, but may be found far out at sea.

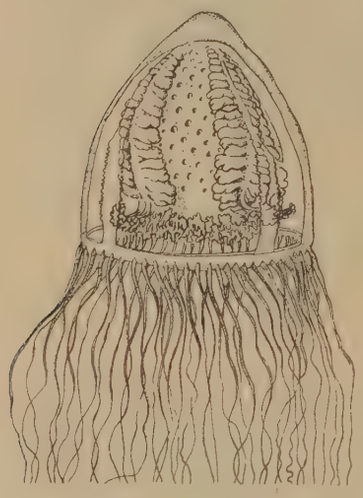


Fig. 6. *Neoturris pileata* (Forskål). — From Hartlaub, Nord. Plankton (the tips of the tentacles are removed).

In the North European seas, *Neoturris pileata* is mainly a summer form, large mature specimens being particularly found in July and August, whereas during the spring mostly small specimens are found.

In the Mediterranean, on the other hand, it seems to have its occurrence during the winter. So it is, at any rate, in the neighbourhood of Trieste; from most other localities we have no records of the date of capture; but as very large specimens were found at Monaco in May (Maas 1904 a), and as the species has been found at Naples in February and March, it seems most likely that its habits are the same in the western area as in the Adriatic Sea. — It seems peculiar, therefore, that the "Thor" never found it during the winter cruise 1908—09. It is worth noticing, however, that in the Mediterranean the species is exclusively recorded from the immediate vicinity of the shore; may be the Mediterranean form of the medusa is more strictly neritic than the Atlantic form; this might account for the absence of the species in the winter samples of the "Thor". Neither was it found during the summer cruise 1910 except on the four above-mentioned stations, on June 24th—25th in the Alboran Sea. The specimens found here were all fairly young (6—12 mm high). The season as well as the size of the specimens do not agree with the statements of the literature regarding the habits of *Neoturris pileata* in the Mediterranean. As a matter of fact, they were all captured in the upper water-layers, about 15—40 m below the surface, *i. e.* in the inflowing Atlantic water. They may belong to the Atlantic stock of the species, having been carried in through the Strait of Gibraltar; it is not excluded, however, that there is really a difference between the seasonal occurrence of the species in the Alboran Sea and elsewhere in the Mediterranean, on account of the fact (further mentioned in the General Part) that the Alboran Sea constitutes a special faunistic area within the Mediterranean.

7. PANDEA CONICA (Quoy & Gaimard) Lesson.

(Fig. 7 and Chart III).

Having reexamined the type specimens of "*Tiara reticulata*" Haeckel from Tristan d'Acunha, and compared them with material of *Pandea* from the Mediterranean, I must agree with Vanhöffen (1911, p. 209) and Hartlaub (1914, p. 340), that "*Tiara reticulata*" is identical with *Pandea conica* (Q. & G.).

Material.

Lat. 36°17′ N., Long. 3°27′ W. — Branner 1869. — 4 specimens. Haeckel determ. *Tiara pileata*.

Stat. 51. Lat. 36°27′ N., Long. 0°37′ W. 18. II. 1909. Y. 300 m wire, 2 specimens, 7—9 mm high.

Stat. 55. Lat. 36°46′ N., Long. 2°18′ W. 19. II. 1909.
Y. 25 m wire, 4 specimens, 5—8 mm high.
- 65 - — 1 — 8 - —
Stat. 57. Lat. 36°40′ N., Long. 3°30′ W. 20. II. 1909.
Y. 25 m wire, 2 specimens, 5 mm high.
Stat. 58. Lat. 36°36′ N., Long. 4°24′ W. 20. II. 1909.
Y. 100 m wire, 1 specimen, ca. 5 mm high.
Stat. 95. 35°57′ N., Long. 6°00′ W. 23. VI. 1910.
Y. 65 m wire, 1 specimen.
Stat. 104. Lat. 36°37′ N., Long. 2°04′ W. 24. VI. 1910.
Y. 65 m wire, 3 specimens, 6—8 mm high.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 4 specimens, 4—7 mm high.
- 300 - — 5 — 4—9 - —
- 1200 - — 1 — 7 - —
Stat. 107. Lat. 36°13′ N., Long. 1°28′ W. 25. VI. 1910.
Y. 65 m wire, 83 specimens, 4—8 mm high.
- 300 - — 12 — 4—7 - —
- 2000 - — 1 — 5 - —
Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 25 m wire, 6 specimens, 5—7 mm high.
- 65 - — 11 — 4—7 - —
- 300 - — 6 — 6—8 - —
Stat. 112. Lat. 36°56′ N., Long. 2°15′ E. 27. VI. 1910.
Y. 65 m wire, 1 specimen, 7 m high.
Stat. 143. Lat. 35°18′ N., Long. 16°35′ E. 23. VII. 1910.
Y. 300 m wire, 1 specimen, 5 mm high.
Stat. 144. Lat. 34°31′ N., Long. 18°40′ E. 24. VII. 1910.
Y. 2000 m wire, 1 specimen, 4 mm high.
Stat. 147. Lat. 31°35′ N., Long. 19°02′ E. 25. VII. 1910.
Y. 25 m wire, 1 specimen, 7 mm high.
Stat. 160. Lat. 35°59′ N., Long. 28°14′ E. 1. VIII. 1910.
Y. 25 m wire, 2 specimens.
- 300 - — 1 — 8 mm high.
Stat. 161. Lat. 36°12′ N., Long. 27°16′ E. 2. VIII. 1910.
Y. 25 m wire, 1 specimen.
Stat. 176. Lat. 40°45′ N., Long. 27°43′ E. 12. VIII. 1910.
Y. 65 m wire, 1 specimen, 4 mm high.
Stat. 192. Lat. 38°07′ N., Long. 15°35′ E. 20. VIII. 1910.
Y. 25 m wire, 1 specimen, 6 mm high.
Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 25 m wire, 1 specimen, 5 mm high.
Stat. 199. Lat. 39°32′ N., Long. 10°49′ E. 25. VIII. 1910.
Y. 25 m wire, 1 specimen.
- 300 - — 1 — 6 mm high.
Stat. 200. Lat. 39°18′ N., Long. 10°11′ E. 26. VIII. 1910.
Y. 25 m wire, 6 specimens, 5—11 mm high.
Stat. 222. Lat. 35°53′ N., Long. 0°57′ W. 4. IX. 1910.
Y. 25 m wire, 5 specimens.
- 300 - — 5 —
Stat. 223. Lat. 36°13′ N., Long. 1°28′ W. 5. IX. 1910.
Y. 25 m wire, 2 specimens.
Stat. 276. ("Pangan"). Lat. 36°30′ N., Long. 19°20′ E. 4. IV. 1911.
2 m ringtrawl, 132 m wire, 4 specimens, ca. 6 mm high.
Stat. 282. Lat. 38°12′ N., Long. 15°37′ E. 8. III. 1911.
2 m ringtrawl, 40 m wire, 1 specimen.
Stat. 297. ("Pangan"). Lat. 33°10′ N., Long. 25°03′ E. 25. VI. 1911.
2 m ringtrawl, 28 m wire, 1 specimen.

Further Distribution.

Mediterranean: Gibraltar (Quoy & Gaimard); "Michael Sars" Stat. 19, 1910, just inside the Strait of Gibraltar, May 2nd 1910, surface (Kramp 1920 a, p. 7). — Harbour of Monaco, surface, in May, abundant (Maas 1904 a, p. 16). — Naples: during the winter and spring this species is very common in the gulf, carried to the surface by the current; the eggs are spawned in March (Lobianco 1888, p. 389; 1903—04, p. 217; 1904, p. 34). — Messina, in the autumn (Köllıker) and in January (Sars; Keferstein & Ehlers).

Outside the Mediterranean: Tristan d'Acunha, Lat. 35° 31′ S., Long. 0° 51′ W. (Haeckel 1879, p. 60, *Tiara reticulata*). — Agulhas Current, southern Atlantic (Vanhöffen 1911, p. 209).

As mentioned by Kramp (1920 a, p. 7), Hartlaub's record of this species as being found in the Bay of Biscay, is due to a mistake. The two finds in the southern Atlantic, mentioned above, are the only cases of *Pandea conica* being found outside the Mediterranean. Vanhöffen tries to account for this peculiar distribution by the polyp generation being attached to floating objects, though, as a matter of fact, we have not the slightest idea of the structure or habits of that polyp.

The Mediterranean localities, from which *Pandea conica* has been known up to now, are rather few, considering the wide and general distribution, shown by the collections of the "Thor" (see Chart III, p. 10). The records in the literature are exclusively from the western basin; but the "Thor" has found the species in several localities in every part of the eastern basin, in the Ægean Sea, and in the Sea of Marmora. Thus the species seems to be generally distributed throughout the Mediterranean and its adjacent areas, except perhaps the Adriatic (it has never been mentioned in the numerous papers on medusæ from that area). As mentioned above, the species occurs at Monaco (Maas 1904 a); it is peculiar, therefore, that it

was never found by the "Thor" in the Balearic Sea (with the Ligurian and Catalonian Seas), with the only exception of stat. 112, near the coast of Algeria.

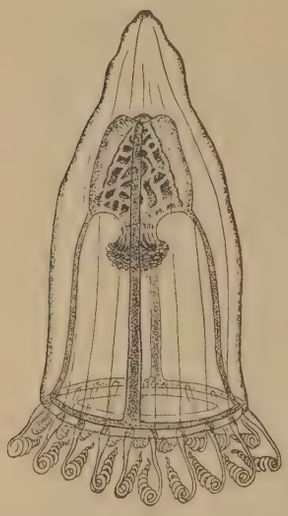


Fig. 7. *Pandea conica* (Quoy & Gaimard). — From Hartlaub, Nord. Plankton.

Let us follow the cruises of the "Thor", looking especially for *Pandea conica*! — On Dec. 5th 1908 the ship entered the Mediterranean and went straight to Messina. During the month of December the Ionian Sea and the neighbourhood of Piræus were examined, while January was spent in the Tyrrhenian and Ligurian Seas and the north-eastern part of the Balearic Sea. *Pandea conica* was never found during these investigations, nor was it met with at the stations along the coast of Algeria during the first half of February. But in the Alboran Sea it was found at four stations, February 18th to 20th; only some few specimens were taken, all of which were middle-sized or fairly small (height 5—9 mm). The vertical distribution comprises the upper 150—200 m, most specimens being found near the surface.

When on the summer expedition of 1910 the "Thor" arrived at the Strait of Gibraltar on June 23rd, a specimen of *Pandea conica* was found at the western entrance to the strait (stat. 95), about 40 m below the surface. On June 24th to 25th numerous specimens (4—9 mm high) were found in the section from Cape Gata (Spain) to Oran (Algeria). The main part were taken at about 40 m depth at stat. 107, the middle point between the two coasts. Still at stat. 112, near the coast of Africa, Long 2° 15′ E., a single specimen was found. On the other hand, the species was completely lacking during the subsequent investigations in the Balearic, Ligurian, Tyrrhenian, and Sidra Seas, from June 28th to July 22nd. It was met with again in the southern part of the Ionian Sea and in the Gulf of Sidra on July 23rd—25th, stat. 143, 144, and 147; only one specimen was found at each station, all fairly small, 4—7 mm high. The smallest individual was found in a haul with 2000 m wire (stat. 144). — Then again it was missing in the Levant, until a few specimens were taken in the upper strata near Rhodes (stat. 160 and 161, August 1st—2nd). One small specimen (4 mm) was found in the Sea of Marmora, stat. 176, August 12th, 65 m wire. The species was not found during the cruise from the Dardanelles through the Corinth Canal toTaormina on Sicily, August 12th—20th. Between August 20th and 26th some few large and middle-sized specimens were found in various localities in the Tyrrhenian Sea. The subsequent investigations in the Balearic Sea failed to find the species, but it was met with again, when the ship once more reached the Alboran Sea, at the beginning of September (stat. 222 and 223), when some middle-sized specimens were secured.

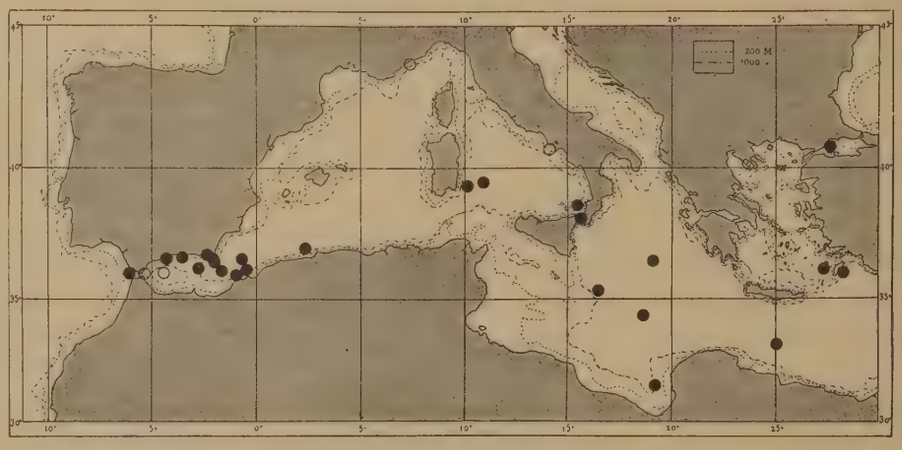


Chart III. ● Finds of *Pandea conica* (Q. & G.), O occurrrence according to the literature.

In the table below (table I) is given a view of the seasons, during which the different areas of the Mediterranean were investigated by the "Thor" (+), the seasons when *Pandea conica* was found being marked with a ⊕. The peculiarities of the occurrence of the species in the western basin are clearly

Table I. Occurrence of *Pandea conica*.

Year	1908—09			1910				
Month	XII	I	II	VI	VII	VIII	IX	
Alboran Sea and stat. 112	..	..	⊕	⊕	..	..	⊕	
Balearic Sea etc.	..	+	+	+	..	+	..	Messina March 1911
Tyrrhenian Sea	..	+	..	..	+	⊕	..	
Sidra Sea	..	..	..	..	⊕	..	..	
Ionian Sea	+	..	..	..	⊕	+	..	April 1911
Levant	..	..	..	..	..	⊕	..	June 1911
Ægean Sea	+	..	..	..	..	⊕	..	
Sea of Marmora	..	..	..	..	..	⊕	..	

⊕ *Pandea conica* found.
\+ *Pandea conica* missing.

demonstrated in the table, and they need an explanation. If the medusa had a strictly defined time of occurrence, one might suggest that the absence in the Balearic and the greater part of the Tyrrhenian Sea might be due to the expeditions having just missed this time of occurrence in the said areas. But this is not the case.

If we comprise all finds of *Pandea conica* in the Mediterranean, hitherto known, we will observe that the species has been found at every season of the year: in the Strait of Messina in the autumn (Kölliker) and in January (Keferstein & Ehlers), in the Gulf of Naples in the winter and spring (Lobianco), at Monaco in May (Maas); the "Thor" has found it in February—April and in June—September. — Moreover we observe that almost everywhere, and at very different seasons, small and larger individuals were found together by the "Thor". Quite young stages were not found (this may be due to the kinds of appliances used by the expeditions). But individuals 4—5 mm high were taken: in the Alboran Sea in February and June, in the Tyrrhenian Sea in August, in the Ionian Sea in July, and in the Sea of Marmora in August. There is, accordingly, no definite season for the breeding; the latter takes place at all seasons. Another thing is that perhaps the liberation of medusæ takes place more extensively at one season than at others. This is indicated by the fact that in the Alboran Sea the medusa was much more numerous in June than in February and September.

There can be no doubt but that the unknown hydroid polyp is a deep-sea form, and that the youngest stages of the medusa keep to the deep-sea. The tiny medusæ (0.5—1 mm high) have only been observed by Keferstein & Ehlers in the Strait of Messina, where, as we know, several deep-sea animals occasionally ascend to the surface. A specimen, 4 mm high, was taken by the "Thor" at stat. 144 in the middle part of the Ionian Sea, in a haul with 2000 m wire out (also in the Alboran Sea, stat. 107, a specimen was taken in a haul with 2000 m wire out, but as at the same time the species was very abundant at the surface, this individual may have been caught during the hauling up of the net). I cannot explain the ostensible absence of the species in the Balearic Sea at the same time as it was present, partly even in considerable quantities, in the Alboran Sea. The peculiar occurrence in the latter is not difficult to explain. As the westward movement of the intermediate water-layers of the Balearic Sea towards the Gibraltar Strait is very slow, the numerous specimens in the Alboran Sea cannot have originated in the Balearic Sea. The young specimens are liberated in the deep-water of the Alboran Sea; while increasing in size they ascend (actively?) into the upper strata, where they are caught by the inflowing current and carried into the Mediterranean, particularly along the north coast of Africa. The matter will be more thoroughly discussed in the General Part.

8. BYTHOTIARA MURRAYI Günther.

(Figs. 8—11 and Chart IV).

Günther 1903, pp. 424—425, Pl. X, figs. 4 and 5.
Maas 1904 b, pp. 429, 432, 433, 434, 436, 437.
Maas 1910, pp. 2—8.
Mayer 1910, p. 185.
Vanhöffen 1911, p. 215.
Vanhöffen 1912 a, p. 363.
Hartlaub 1913, p. 355.

Material.

Stat. 39. Lat. 39°41′ N., Long. 10°02′ E. 1. II. 1909.
Y. 1000 m wire, 1 specimen, 10 mm high.
Stat. 115. Lat. 38°17′ N., Long. 4°11′ E. 29. VI. 1910.
Y. 2000 m wire, 1 specimen, 12 mm high.
Stat. 160. Lat. 35°59′ N., Long. 28°14′ E. 1. VIII. 1910.
Y. 1000 m wire, 1 specimen, 12 mm high.
Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 1200 m wire, 1 specimen, 5 mm high.
Stat. 199. Lat. 39°32′ N., Long. 10°49′ E. 25. VIII. 1910.
Y. 1000 m wire, 1 specimen, 12 mm high.
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Y. 1000 m wire, 1 specimen, 15 mm high.
- 2000 - — 1 — 7 - —

Further Distribution.

Mediterranean: Lat. 37°39′ N., Long. 0°20′ E. (south-western part of the Balearic Sea), July 13th 1908, Prince of Monaco stat. 2699. — Lat. 42°55′ N., Long. 5°27′ E. (northern part of the Balearic Sea), Sept. 12th 1909, Prince of Monaco stat. 2937[1]. — Lat. 43°40′ N., Long. 7°35′ E. (near Monaco), May 7th 1909, Prince of Monaco stat. 2836 (Maas 1910). — Near Capri (Mayer 1910).

Outside the Mediterranean: West-coast of Norway: Hjörundfjord, July 5th 1906, in deep water; Herlöfjord, July 30th 1907, in deep water (Damas). — Norwegian Channel, off Lindesnæs, Febr. 22nd 1913 (Hartlaub 1913, p. 356). — Lat. 52°18′ N., Long. 15°14′ W., west of Ireland (Günther). — Lat. 51°00′ N., Long. 11°43′ W., south-west of Ireland June 15th 1905 ("Thor", Zool. Mus. Copenhagen). — Off the mouth of Congo river (Vanhöffen 1912 a). — West of Sumatra (Vanhöffen 1911[2]).

In so far as records of the depth are in hand, all specimens of *Bythotiara murrayi*, hitherto known, are found at a considerable distance from the surface, mostly in the intermediate strata above great depths. The species is an oceanic deep-sea form, and its known area of distribution reaches from the fiords of Norway through the eastern Atlantic (and the Mediterranean) to the East-Indian Islands. Up to now it has never been found in the western Atlantic nor in the Pacific, so that it seems premature to characterize it as a cosmopolitan species.

As *Bythotiara murrayi* has already been mentioned in the literature from the Mediterranean, it is not surprising that it was found in several deep-water hauls by the "Thor", the investigations of which in the deep parts of the Mediterranean far surpass all previous investigations in extent as well as profundity. Hitherto only 4 specimens were known, all from the western basin. The "Thor" has taken altogether 7 specimens from 6 localities, 5 of which in the western basin (see Chart IV). The presence of the species in the eastern basin is demonstrated by the find of a specimen at stat. 160, near Rhodes.

[1] Maas only gives the numbers of the stations and the depth of the hauls. Hartlaub (1913, p. 356) gives the positions according to the Bull. Monaco. The position stated for stat. 2937 is, however, not correct. In the Bulletin no. 157 the position of the station is given as Lat. 42°55′ N., Long. 3°07′ E. of Greenwich. That place is close by the shore near Narbonne, and accordingly no haul from 1150 m depth may have been made here. On the adjacent map the station is found off the coast between Marseille and Toulon, Long. 5°27′ E. of Greenwich. There is, accordingly, an error in the list. This error is easily explained: In the list the longitudes are reckoned from Greenwirh, but the longitude 5°27′ E. of Greenwich corresponds with 3°07′ E. of the Paris meridian. The error is due, accordingly, to the author of the list having forgotten to recalculate the position from Paris to Greenwich.

[2] In the heading Vanhöffen mentions Browne as the author of *Bythotiara murrayi*. As far as I am aware, Browne has never dealt with this species, far less named or described it.

As in other deep-sea medusæ, the development of *Bythotiara* is independent of the season of the year. A specimen 10 mm high was found in February, and the sizes of individuals taken in August range from 5—15 mm height of the bell.

The smallest specimen found (stat. 194) is interesting, in so far as its gonads are mature. The height of the bell is only 5 mm; in contradistinction to most of the other specimens (see below) it has 8 radial canals, regularly and normally developed. The mature eggs have penetrated the epithelium of the manubrium and are situated like a pavement on the outer sides of the stomach, whence they easily drop off when touched. It is, however, not at all uncommon among craspedote medusæ to find mature sexual products in individuals, far smaller than full-grown specimens of the species.

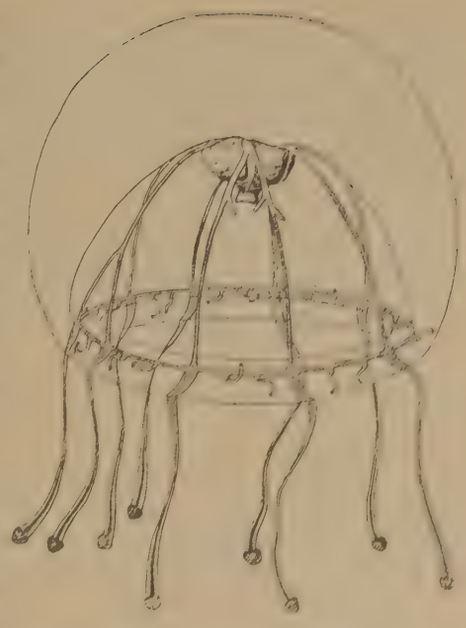


Fig. 8. *Bythotiara murrayi* Günther. — From Hartlaub, Nord. Plankton; the specimen from the Norwegian Channel, mentioned in the text.

Morphological remarks.

In his description Hartlaub (1913, p. 355) states that *Bythotiara murrayi* lacks mesenteries. This is not quite correct. Mesenteries are present in the same manner as in *Calycopsis typa* ("langschlitzförmige Verbindung" between the primary radial canals and the manubrium, see Hartlaub loc. cit. p. 360), but certain conditions of contraction give the impression that no mesenteries are present. When the manubrium is contracted in circular direction, getting an elongated shape, it is easily observed that the primary radial canals are connected with the perradial edges of the manubrium in the proximal $^1/_3$ or more of the latter (see Mayer 1910, fig. 98 A, p. 185). But when the manubrium is contracted in vertical direction, being broad and flattened (see Hartlaub 1913, fig. 306, p. 357), with the proximal parts of the side-walls turned upwards and constituting the dorsal plane of the manubrium, then the radial canals seem to issue from the corners of the stomach without being connected with the perradial side-edges of the latter. Among the specimens of the "Thor" both conditions of contraction are represented.

Chart IV. ● Finds of *Bythotiara murrayi* Günther, ○ occurrence according to the literature. ▲ Finds of *Tiaranna rotunda* (Q. & G.), △ occurrence according to the literature.

Marginal organs. — Günther only found the primary tentacles. Maas (1910) described their peculiar mode of insertion, the tentacles issuing from the exumbrella at some distance from the circular canal (see figs. 8 and 9); moreover he demonstrated that the tentacles have a terminal knob. Maas also observed the small secondary tentacles; he rightly remarked that they are not cirri, but real diminutive tentacles; they may be present in a number of 1—5 between every successive pair of the primary tentacles, and their distribution is irregular. On the other hand, according to the description by Hartlaub (1913) the number of secondary tentacles is constantly 2

between every successive pair of primary tentacles, and he demonstrates that they issue in the same manner as the latter. Such regular distribution of the secondary tentacles naturally implies a regularity in the course of the radial canals and a subsequent regular distribution of the primary tentacles. As a matter of fact, as regards the course of the radial canals the present material from the Mediterranean is very variable and irregular (see below), but it is very likely that the normal distribution of the secondary tentacles is really such as described by HARTLAUB. I have found, however, that there is still a third kind of marginal organs, a kind of tertiary tentacles, far smaller than the secondary tentacles. Fig. 9 shows a portion of the bell margin of *Bythotiara* with 2 primary, 1 secondary, and 3 tertiary tentacles. Only in a few cases I have found these tertiary tentacles preserved, and I cannot, therefore, state their normal number. Their shape is interesting: they are short, cylindrical bodies, issuing directly from the circular canal; they are a little narrowed at the base. They are hollow and possess an ectoderm consisting of one layer of fairly high cells. The entire ectoderm is provided with elongated, vertically placed nematocysts (see fig. 10). These bodies remind one of, and are certainly homologous with, the dwarf-tentacles described by me in *Tiaranna rotunda* (KRAMP 1919 and 1920 a); in that species, however, the dwarf-tentacles are only provided with nematocysts in the distal part. Moreover these dwarf-tentacles are homologous with the primitive, nematocyst-bearing cordyli in the Leptomedusa *Chromatonema* and thereby with the proper cordyli in the other *Laodiceidæ*.

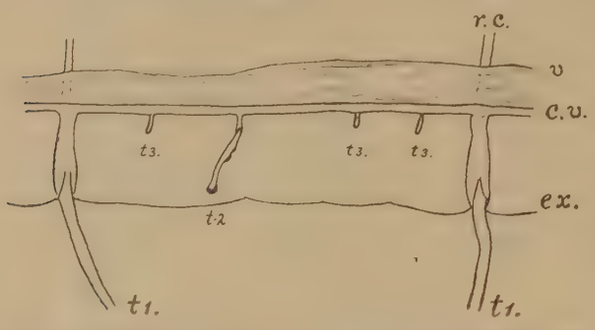


Fig. 9. *Bythotiara murrayi.* — Part of the bell margin, seen from the adaxial side. t_1, t_2, t_3, tentacles of first, second and third series; *ex*, exumbrella; *c. v.* circular vessel; *v*, velum; *r. c.*, radial canal. — Specimen from "Thor", stat. 39.

Variation in the course of the radial canals. — *Bythotiara murrayi* normally has 4 radial canals, each of which bifurcates at a short distance from the point of issue, forming two branches, both reaching the circular canal. Even in the smallest specimens known it is impossible to distinguish any difference in the dimension of the two branches or the corresponding tentacles. As, moreover, the two branches diverge equally from the perradial direction, there can be no doubt, but that this first branching is properly a primary phenomenon, both of the branches being of the same age; it is not one primary canal with a secondary side-branch. In normally developed specimens the course of the radial canals is exactly the same, whether the individual is small or large. On the other hand, it is not uncommon to find a greater number of canals than the normal eight. This is, indeed, not a normal feature of age, but always an anomaly. It may occur in fairly small individuals, and if one or more of the canals have a greater number of branches than normally, one of the other canals is not rarely found to be quite unbranched. Irregular development of the radial canals is, indeed, remarkably frequent in this species. The specimen from Capri, described by MAYER (1910) has 5 gonads and 5 primary canals, one of which is unbranched. Among the 3 specimens, mentioned by MAAS, one has an extra side-branch on one of the canals. The same anomaly is found in VANHÖFFEN's specimen from Sumatra, and in HARTLAUB's specimen from the Norwegian Channel. The latter is further interesting by two of the canals possessing 1—2 short, blindly ending side-branches (see fig. 8, which is a reproduction of HARTLAUB's figure). Very peculiar is the West-African specimen, mentioned by VANHÖFFEN, in which all of the canals are said to bifurcate twice, altogether 16 canals being connected with the circular vessel. Such a regularity stands in a striking contradistinction to other experiences on specimens with supernumerary radial canals.

Fig. 10. *Bythotiara murrayi.* — Tentacle of third series, dwarf-tentacle, "cordylus". — "Thor" stat. 39.

Among the 7 specimens from the Mediterranean, examined by me, no less than four exhibit an abnormal development of the radial canals. I am going to describe these four specimens (see figs. 11 a—d).

1. — Stat. 115 (fig. 11 a), — Height of the bell 12 mm, diam. 11 mm. Only 3 gonads and 3 primary radial canals are present; the latter are numbered in the figure I, II, and III: — I, bifurcated, one of the branches (I a) further bifurcated. — II, altogether unbranched. — III, divided at the base into two highly diverging parts; the first part (III a) forms an "eye" near the circular vessel; III b is divided into three branches. Thus, in spite of the reduced number of primary canals, the circular vessel still is reached by 8 canals. There is one tentacle corresponding to each of these radial canals, except in the case of III a, outside of which two tentacles, abnormally developed are situated close together.

2. — Stat. 160 (fig. 11 b). — Height 12 mm. — Radial canals: I, unbranched. — II and III, normal, bifurcated. — IV, divided into three branches, two of which are connected by an anastomosis. — Thus 8 canals open into the circular vessel; 8 tentacles corresponding to the canals.

3. — Stat. 199 (fig. 11 c). — Height 12 mm. 4 gonads; radial canals: I, bifurcated near the circular vessel. — II, bifurcated near the manubrium. — III, absent! — IV (the one figured), several irregular branches and anastomoses, 6 branches reaching the circular vessel. — Thus in this specimen altogether 10 canals open into the circular vessel; there are 9 tentacles, none being found outside the canal I, b.

4. — Stat. 209 (fig. 11 d). — Height 15 mm, diam. 13 mm. — Radial canals: I, divided into 3 branches: I, a, I, b, 1, and I, b, 2, the latter forming an "eye" near the distal end. — II, bifurcated, normal. — III and IV (figured), irregularly branched and partly confluent, as shown in the figure. — Thus altogether 8 canals open into the circular vessel, but there are 9 tentacles, two of which are placed closely together outside the conflux of canals of the system III—IV.

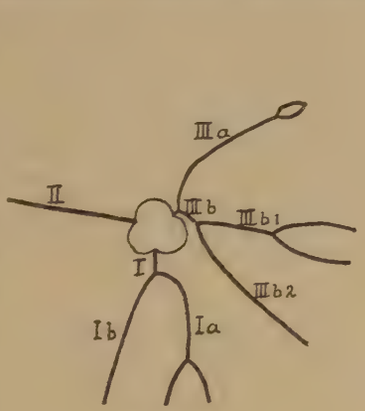


fig. 11 a.

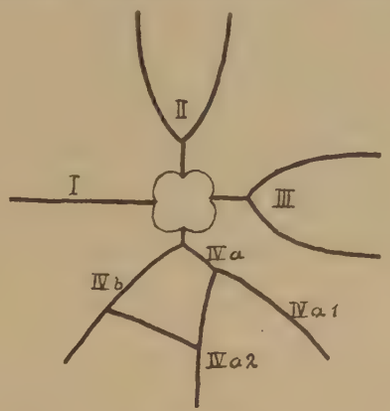


fig. 11 b.

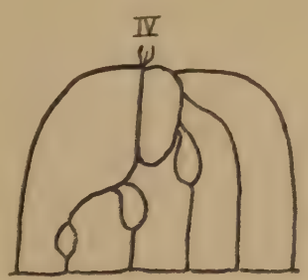


fig. 11 c.

fig. 11 d.

Fig. 11 a—d. *Bythotiara murrayi.* — Diagrams of the course of radial canals in four specimens from the Mediterranean. For further explanation, see the text p. 15.

Supernumerary radial canals are, probably, formed in two different ways: In cases as when a canal bifurcates into two equally diverging branches (as in stat. 115 I, a and III, b, 1; stat. 160 IV, a) the bifurcation has undoubtedly taken place at an early stage during the growth of the canal towards the bell margin, before the latter was reached; likewise in cases when the two branches unite once more, forming an "eye". In other cases supernumerary branches are certainly side-branches, developed from a canal, either during its growth or after its having reached the circular vessel. The blind canals in HARTLAUB's specimens are examples of the latter case. — In normal individuals the connecting points between the 8 radial canals and the circular vessel are, as a rule, equidistant, and in the abnormal individuals there

is a marked tendency to establish, so to speak, the same result in the end: if one of the primary canals is unbranched (or absent), the neighbours usually get a greater number of branches than normally so that the empty room is filled up.

Maas as well as Hartlaub have strictly pointed out that the branches of the radial canals in *Bythotiara* are developed in a centrifugal direction, in contradistinction to *Sibogita*, which has 4 primary radial canals and a number of centripetal canals, issuing from the circular vessel and opening into the primary canals. In a specimen of *Bythotiara* from the Atlantic, south-west of Ireland, I have, however, seen a real centripetal canal, running from the circular vessel upwards on the subumbrella and terminating blindly at some distance from the manubrium. Accordingly centripetal canals may also occur in *Bythotiara*, as an abnormity.

Beside the specimens, mentioned here, I have seen 6 other specimens of *Bythotiara murrayi, viz.* from the Hjörundfiord on the west coast of Norway; all these individuals are normally developed. Thus we know quite a number of specimens of this species from the Atlantic and the adjacent parts of the Norwegian Sea and the North Sea; among these specimens no abnormities are found, except the few cases, when a single radial canal has one supernumerary branch. On the other hand, among the 11 specimens from the Mediterranean, hitherto known, no less than 5 are highly abnormal, a very striking fact.

LEPTOMEDUSÆ.

9. LAODICEA UNDULATA (Forbes & Goodsir).

Fig. 12.

Synonyms, see Kramp 1919, p. 16.

Material.

Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 2 specimens, diam. 5 mm.
- 300 - — 2 — — 7 -
- 1200 - — 1 — — 7 -

Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 65 m wire, 1 specimen, diam. 4 mm.
Stat. 210. Lat. 41°10′ N., Long. 2°23′ E. 30. VIII. 1910.
Y. 25 m wire, 1 specimen, diam. 9 mm.

Further Distribution.

Mediterranean: Villefranche (Metschnikoff 1886, *L. cruciata*). — Naples, "occasionally during the winter of 1907—08" (Mayer 1910, *L. cruciata*). — Messina, winter 1852—53 (Gegenbaur 1856, *Thaumantias mediterranea*, see fig. 12). — Trieste (Graeffe 1884, *L. cruciata*; Neppi & Stiasny 1911 and 1913, *L. cruciata* and *L. bigelowi*.)

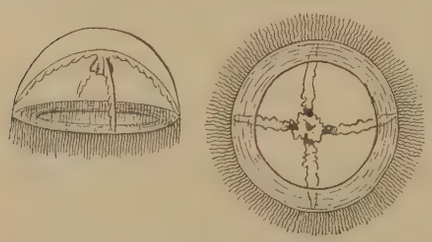


Fig. 12. *Laodicea undulata* (Forbes & Goodsir) = "Thaumantias mediterranea" Gegenbaur.

Outside the Mediterranean: Widely distributed in the Atlantic Ocean and adjacent seas, probably also in the Pacific and the Indian Ocean (for details, see Kramp 1919, p. 25).

In my paper of 1919 I have set forth my reasons to use the specific name *undulata* for this species, and in the same paper I have discussed the various forms of *Laodicea* and their distribution.

In 1911 Neppi & Stiasny mention two species of *Laodicea* from Trieste, and in 1913 they give a more thorough description of both: *L. cruciata*, diameter up to 6 mm, with 20—30 tentacles; and *L. bigelowi* n. sp., diam. 7 mm, with about 70 tentacles, without marginal cirri. — All specimens, found by the "Thor", are fairly small, 4—7 mm in diameter. The large number of tentacles separates them from the "*L. cruciata*" of Neppi & Stiasny. They agree, on the other hand, in every respect with the description of "*L. bigelowi*", except that they are provided with cirri. They confirm, therefore, my supposition (Kramp 1919) that *L. bigelowi* is identical with *L. undulata*. Basal tentacular spurs are likewise present. — The number of tentacles is, indeed, very

large in relation to the size of the individuals, *viz.* diam. 4 mm, about 65 tentacles; diam. 5 mm, about 100 tentacles; diam. 7 mm, about 150 tentacles. The largest individuals found have somewhat well developed gonads; it is very likely, therefore, that the Mediterranean individuals do not grow to such a considerable size as do the specimens of the North Atlantic Ocean.

All of the localities, in which this species was found by the "Thor", are in the western part of the Mediterranean: in the Alboran Sea, and near the east coast of Spain. At stat. 106 a specimen was taken in a haul with 1200 m wire out, but as on the same station some specimens were found in the upper strata, it is possible that the foresaid individual was really caught during the hauling up of the net through the upper strata.

As regards the seasons, in which this species occurs in the Mediterranean, the statements of the literature agree that it is found at Naples and Messina in the winter; at Trieste "*L. cruciata*" occurs in October—December, "*L. bigelowi*" in July. — Most of the specimens from the "Thor" were found towards the end of June, but there was also found a specimen in August, and it was larger than the others (diam. 9 mm). This might indicate that in the western part of the Mediterranean the species has its occurrence in the summer; the material from the "Thor" of this neritic medusa is, however, so small that no reliable conclusions can be drawn concerning the general biology of the species in the Mediterranean.

10. MITROCOMA CIRRATA (Haeckel).

Fig. 13.

Material.

Stat. 95. Lat. 35°57′ N., Long. 6°00′ W. 23. VI. 1910.
Y. 65 m wire, 1 specimen, diam. 4 mm.
Stat. 99. Lat. 36°02′ N., Long. 5°16′ W. 24. VI. 1910.
Y. 65 m wire, 6 specimens, diam. 5—7 mm.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 23 specimens, diam. 3—6 mm.
Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 65 m wire, 33 specimens, diam. 3—6 mm.

This species was described by Haeckel (1879, p. 182, Taf. XI, figs. 9—11) under the name of *Mitrocomium cirratum* nov. gen., nov. sp. In agreement with Mayer (1910) I find no sufficient reason to separate this form from the genus *Mitrocoma*. — Haeckel's specimens were found near Corfu, which, up to 1910, was the only locality, from which the species was known. Mayer (1910, p. 288) found it at Naples, but he states that it is a rare species. It is interesting, therefore, that the "Thor" has caught this medusa fairly abundantly in the Alboran Sea. Evidently the species only occurs in the upper strata, and as in the Strait of Gibraltar the upper water-layers are mainly moving inwards towards the Mediterranean, there is, evidently, no great possibility for the species being carried into the Atlantic. This may, however, eventually happen, as demonstrated by the find of an individual at stat. 95, in the limit between the Strait of Gibraltar and the Cadiz Bay. The medusa is, undoubtedly, a well-marked neritic species; this may be the reason, why the "Thor" did not find it in other localities in the Mediterranean.

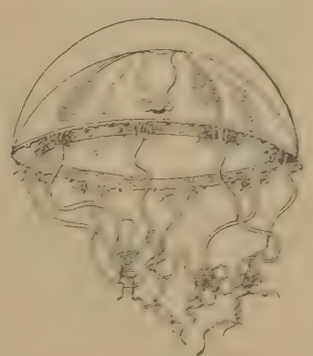


Fig. 13. *Mitrocoma cirrata* (Haeckel). — After Haeckel 1879 (from Mayer 1910).

According to the literature the medusa may grow to a size of 16 mm in diameter. The specimens from the "Thor" do not surpass 7 mm in diameter. They were all found towards the end of June. When the ship returned to the same area at the beginning of September, the species had disappeared. It is, therefore, probably a seasonal form, the medusa being liberated in the spring, reaching half size about July 1st, maturity in the warm summer-time, whereafter it disappears.

11. PHIALIDIUM HEMISPHÆRICUM (L.).

(Fig. 14).

Material.

Stat. 87. Lat. 37°03′ N., Long. 9°15′ W. 17. VI. 1910.
Y. 65 m wire, 4 specimens, diam. 5—7 mm.
Stat. 94. Lat. 36°06′ N., Long. 6°02′ W. 23. VI. 1910.
Y. 65 m wire, 3 specimens, diam. 3—7 mm.
Stat. 139. Lat. 37°57′ N., Long. 11°54′ E. 20. VII. 1910.
Y. 800 m wire, 1 specimen, diam. 5 mm.
Stat. 174. Lat. 40°54′ N., Long. 28°53′ E. 11. VIII. 1910.
Y. 65 m wire, 5 specimens, diam. 3—5 mm.

Further Distribution.

Mediterranean: Strait of Gibraltar, Nice, Naples, Messina, Corfu (Carus 1884, p. 31; *Phialidium variabile*). — Villefranche (Metschnikoff 1886, p. 5—8, *Clytia flavidula* and *viridicans*). — Naples, in the spring (*ibid.*, *Clytia flavidula*), Naples, during the winter (Lobianco 1888, p. 387, *Clytia johnstonii*; Mayer 1910, p. 266, *Phialidium hemisphæricum*). — Off the coast of Dalmatia, June and July (Neppi 1912, p. 728, *Ph. variabile*). — Trieste, winter and spring (Graeffe 1884, p. 24, *Ph. variabile*; Neppi & Stiasny 1913, p. 44, *Ph. variabile*, non *Thaumantias hemisphærica*, p. 36).

Outside the Mediterranean: Very common off the coasts of the northern Europe as far northwards as the south coast of Iceland.

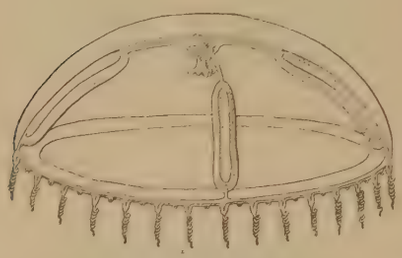


Fig. 14. *Phialidium hemisphæricum* (L.). — From Mayer 1910.

The question of the limitation of the various "species" of *Phialidium* is very difficult, partly owing to the remarkable variability with regard to size, number of tentacles, shape and position of the gonads etc. Within the species *Phialidium hemisphæricum* we find every transition between small forms with short, oval gonads in the distal parts of the radial canals, and larger forms with elongated or linear gonads more or less distant from the circular vessel. I have come to the conclusion that, in the northern Europe, the first of these forms mainly occurs in the summer, the latter in the winter. Graeffe (1884) thought to have made a similar observation at Trieste. Neppi & Stiasny, on the other hand, have found both of the extremes, and transitional forms as well, but they deny that the seasons have anything to do with this variation. — Metschnikoff mentions a series of characteristics, supposed to separate the two forms described by him (*Clytia flavidula* and *viridicans*) to such a marked degree "dass an ein Zusammenwerfen derselben nicht gedacht werden kann" (1886, p. 6); to prove this assertion he presents a series of figures for the number of tentacles and marginal vesicles in relation to the size of the individuals. It seems to me, however, that the differences set forth by Metschnikoff fall within the limits of variation, as we know them in *Phialidium hemisphæricum* from other localities. — The medusa described by Neppi & Stiasny (1913, p. 36) as "*Thaumantias hemisphærica* Eschscholtz" has, I think, nothing to do with *Phialidium*.

The localities, in which this neritic medusa was found by the "Thor", are very far distant from one another. stat. 87 is near the south-west point of Portugal, stat. 94 just outside the Strait of Gibraltar. In these two localities altogether 7 specimens were found, all in the upper strata (65 m wire). The individuals are so well preserved that I have been able to count the tentacles with tolerable exactness:

Diam. 3.5 mm,	about	16	tentacles	(2 specimens).		
— 5	—	— 23	—	gonads	tiny, elongated, distal.	
— 5	—	— 31	—	—	short, oval, near the circular vessel.	
— 6	—	— 35	—	—	fairly short and thick, at some distance from the circular vessel.	
— 7	—	— 38	—	—	elongated, median.	
— 7	—	— 40	—	—	elongated, in the distal half part of radial canals.	

At stat. 139, off the western end of Sicily, a specimen, 5 mm wide with about 16 tentacles, was taken in a haul with 800 m wire out. — Stat. 174 is in the Sea of Marmora; the 5 small specimens from this locality are badly preserved, so that nothing can be stated as regards the tentacles or the gonads.

12. OCTOCANNA FUNERARIA (Quoy & Gaimard).

(Fig. 15 and Chart V).

Dianœa funeraria Quoy & Gaimard 1827, p. 184, pl. 6, figs. 10—15.
Octocanna funeraria Maas 1911, p. 3.

Material.

Stat. 18. Lat. 37°51′ N., Long. 23°14′ E. 30. XII. 1908.
Y. 300 m wire, 2 specimens, diam. 10—18 mm.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 1200 m wire, 12 specimens, diam. 8—18 mm.
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Y. depth unknown, 3 specimens, diam. 19—20 mm.
- 1000 m wire, 4 — — 14—23 -

Haeckel (1879, p. 261) considered the medusa "*Dianœa funeraria*", described and figured by Quoy & Gaimard to be a Trachymedusa belonging to the genus *Trachynema* Gegenbaur, and he identified the species with the Mediterranean medusa "*Sminthea leptogaster*" Gegenbaur. Subsequent authors have doubted the correctness of this view, but no better suggestion as to the identity of the species was brought forward until Maas, in his little paper in the Bulletin de l'institut océanographique (1911), demonstrated that "*Dianœa funeraria*" is a Leptomedusa of the genus *Octocanna* Haeckel. Maas rightly referred that genus to the family *Eucopidæ*. In fact, the genus is closely allied to *Phialidium*.

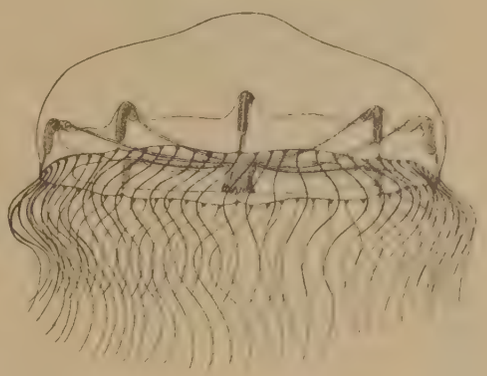


Fig. 15. *Octocanna funeraria* (Quoy & Gaimard). — Specimen from Norway, drawn by Damas.

Maas has given an excellent new description of the species, to which I refer. As regards the morphology I shall only mention a peculiar abnormal specimen, from stat. 209, 1000 m wire. The diameter is 18 mm and there are 13 radial canals. Four of the canals are distinguished as the primary ones carrying well developed gonads, whereas the gonads on the secondary canals are very tiny. The four primary canals are almost regularly placed in the perradii of the animal, dividing the bell into four quadrants of nearly equal size. The secondary canals are unequally distributed within the quadrants. Two neighbouring quadrants are normal, each containing one secondary canal. All of the supernumerary canals are crowded in the two other quadrants, one of the latter containing 5, the other 2 secondary canals.

Chart V. ● Finds of *Octocanna funeraria* (Q. & G.), ○ occurrence according to the literature.

Distribution (see Chart V). The material, examined by Maas, consists of 8 specimens from the following localities: Lat. 43° 33′ N., Long. 7° 35′ E. (near Monaco); Lat. 43° 00′ N., Long. 5° 27′ E. (near

Marseille). Lat. 38°20′ N., Long. 1°31′ E. (south of Ibiza); Lat. 36°48′ N., Long. 0°18′ W. and Lat. 36°18′ N., Long. 2°31′ W. (Alboran Sea). — Quoy & Gaimard found the species in the Strait of Gibraltar. "Thor" stat. 106 is in the Alboran Sea, stat. 209 in the Catalonian Sea. Moreover, I have seen two specimens, found near Villefranche by Damas, April 1913. Thus up to now the species has been found in 9 localities in the western part of the Mediterranean, between Monaco and the Strait of Gibraltar. But it also occurs in the eastern basin, as demonstrated by two specimens from "Thor" stat. 18, near Piræus.

Octocanna funeraria inhabits the deeper strata. As in other deep-sea medusæ, the size of the individuals exhibits no correlation to the seasons of the year.

13. EIRENE VIRIDULA (Péron & Lesueur).

(Fig. 16).

Some badly preserved young medusæ from the following localities probably belong to this species:

Stat. 69. Lat. 36°13′ N., Long. 9°48′ W. 28. II. 1909.
Y. 65 m wire, 3 specimens, diam. 12—14—19 mm.
Stat. 94. Lat. 36°06′ N., Long. 6°02′ W. 23. VI. 1910.
Y. 65 m wire, 13 specimens, diam. 5—11 mm.
Stat. 136. Lat. 37°01′ N., Long. 10°31′ E. 19. VII. 1910.
Y. 100 m wire, 3 specimens, diam. ca. 6 mm.

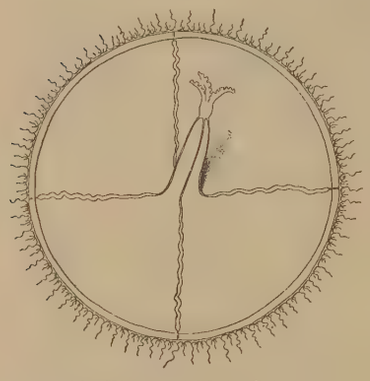


Fig. 16. *Eirene viridula* (Péron & Lesueur). — From Mayer 1910.

The two first named localities are in the Atlantic Ocean, in the vicinity of the Strait of Gibraltar; stat. 136 is in the Mediterranean, at the coast of Tunis.

Further Distribution: The coast of Europe from the North Sea to the Mediterranean, "occasionally found at Naples, on the surface" (Mayer 1910, p. 312).

14. AEQUOREA FORSKÅLEA Péron & Lesueur.

(Fig. 17).

Syn. see Mayer 1910, p. 325.

Material.

Stat. 123. Lat. 44°14′ N., Long. 8°55′ E., near Genoa. 3. VII. 1910.
Y. 10 m wire, 1 specimen, diam. 29 mm.
Stat. 183. Lat. 37°52′ N., Long. 23°09′ E., near Corinth. 16. VIII. 1910.
Y. 65 m wire, 1 specimen, diam. 13 mm.
Stat. 210. Lat. 41°10′ N., Long. 2°23′ E., near Barcelona, 30. VIII. 1910.
Y. 25 m wire, 1 specimen, diam. about 120 mm.

This wellknown conspicuous medusa is occurring along the coasts of Europe from the northern part of Norway to the Mediterranean and may occasionally be met with in the Skagerrak. It further occurs at the part of the coast of North America which is washed by the Gulf Stream. As to number of radial canals, tentacles and marginal vesicles as well as form and relative size of stomach and mouth it is most variable, consequently it has been described under several different specific and generic names. A series of nearly related species are found in the Indo-Pacific region.

Distribution in the Mediterranean.

Cette, Nice, Spezia, Naples, Messina, Lesina (Dalmatian coast), Milo (the Ægean Sea) (Carus 1884, p. 33—34, *Aequorea discus, Ae. forskålea, Ae. violacea, Mesonema pensile, M. eurystoma, Polycanna rissoana*). — Further: Naples, with mature eggs in March (Lobianco 1888, p. 390, *Zygodactyla rosea*). — The Dalmatian

coast, July 1911, diam. 9—13 cm (NEPPI 1912, p. 729). — Trieste: according to GRAEFFE (1884, p. 359) *Aequorea forskålea* occurs in great numbers at Trieste (all through the winter); the largest specimens are found in March and April when it is breeding time; in summer and when autumn sets in it disappears. — NEPPI & STIASNY (1913, p. 53) have subjected this species to thorough investigations, based on abundant living material from Trieste, and hereby prove the justification of uniting the many Haeckelian species in a single one. According to these authors *Aequorea forskålea* occurs at Trieste all the year round and most numerously from December to April. — MAAS (1904 a, pp. 21—24) in contradistinction to most of the other recent authors thinks that the genus *Polycanna* ought to be maintained as distinct from *Aequorea*. MAAS has examined a great many specimens of *Ae. forskålea* from Villefranche; the Prince of Monaco collected a young specimen of the same species, 20 mm in diameter, in the Golfe de Gascogne, 47°33′ N., 8°31′45″ W., 30. VIII. 1885. A large specimen of "*Polycanna rissoana*" was taken in the harbour of Monaco, 18. V. 1897.

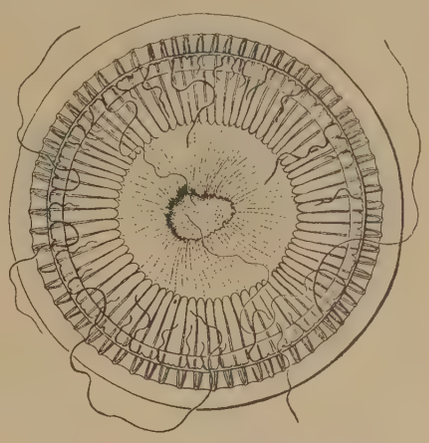


Fig. 17. *Aequorea forskålea* Péron & Lesueur. — From Mayer 1910.

Aequorea forskålea thus appears to be distributed all over the Mediterranean, and is stated as most numerous in several places. It seems to be strongly neritic; this is not only evident from the literature, but the 3 localities in which this species was collected by the "Thor" and which are at great mutual distances, all are found very near by land, and the 3 specimens were all taken close by the surface, whereas this species was never found by the "Thor" at any of the many stations at greater distance from the coast, neither in winter nor in summer.

Without entering on a discussion of the question of species, I shall give a few precise data (measures etc.) of the 3 specimens.

Diameter	Diam. of stomach	Length of mouth tube	Number of radial canals	Number of tentacles, fully developed
13 mm	6 mm	4,5 mm	ca. 75	16
29 —	17 —	5 —	ca. 87	18
ca. 120 —	ca. 60 —		65	

TRACHYMEDUSÆ.

15. GOSSEA CORYNETES (Gosse).

(Fig. 18).

Material.

Stat. 1. Lat. 49°17′ N., Long. 4°13′ W. 28. XI. 1908. Y. 25 m wire, 4 specimens, diam. 5—6 mm.

Stat. 247. Lat. 48°43′ N., Long. 4°45′ W. 19. IX. 1910. Y. 65 m wire, 2 specimens, diam. 8—9 mm.

This peculiar little medusa seems to have a very narrowly limited area of distribution, having as yet only been met with in the Channel and in the adjacent parts of the North Sea and of the Atlantic.

It was described by GOSSE (1853, *Thaumantias corynetes*) from Ilfracombe on the Devonshire Coast according to a younger specimen, 6 mm wide and 8 mm high with 16 (8 × 2) tentacles. HAECKEL (1879) reproduces Gosse's description (p. 251) and goes on to describe (p. 252, Taf. 18, fig. 4) the full grown medusa (see fig. 18), 12 mm wide, 10 mm high, with 24 (8 × 3) tentacles, as a new species, *Gossea circinata* from St. Nazaire on the southern (atlantic) coast of Britany. — The Misses DELAP (1905, p. 14, *Gossea circinata*) have collected it at Valencia Harbour, on the south-west coast of Ireland, a single time

in September, several times in November, up to 16 mm in diameter and 10 mm high. Further it is often mentioned in the international plankton-catalogues (1906, p. 71; 1909, p. 80; 1916, p. 44) from the Channel in August and November, and, besides, a few times from the south-western part of the North Sea off the coast of Belgium in August; finally a single time from the Irish Sea in November.

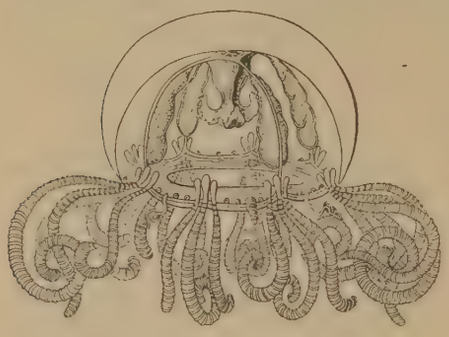


Fig. 18. *Gossea corynetes* (Gosse). — After Haeckel 1879 (from Mayer 1910).

The two localities in which the species has been taken by the "Thor" both belong to the Channel, and therefore do not extend the hitherto known area of distribution of the species; the season (Sept. and Nov.) likewise confirms the statements of the literature which all agree in ascribing the occurrence of this species to the months of autumn. It is, however, noteworthy that the specimens from September are considerably larger and more developed than those from November. The small specimens have the complete number of tentacles, in so far as it has been possible to count them. — In one respect HAECKEL's description is obscure and his figure wrong, as it is implied that the tentacles have basal "spurs" (see fig. 18), which they have not, they issue exactly as in *Gonionemus*.

16. PANTACOGON RUBRUM Vanhöffen.

(Fig. 19).

? P. haeckelii Maas.

Material.

Stat. 76. Lat. 47°01′ N., Long. 5°48′ W. 10. III. 1909. Y. 1600 m wire, 1 specimen, diam. 9 mm, height 9 mm.

Stat. 181. (1906). Lat. 49°22′ N., Long. 12°52′ W. 4. IX. 1906, depth 1350 m. Y. 1800 m wire, 5 specimens, diam. 8—10 mm, height 7—8 mm.

I have formerly (KRAMP 1913, p. 274 ff.) mentioned the possibility of this species being identical with *P. haeckelii* Maas; MAAS who has examined specimens of both species maintains that they are not identical. Apart from the two specimens of "*P. haeckelii*" from the Irminger Sea *P. rubrum* was not known from the North Atlantic region until 1913; till then its known distribution was the following: The tropical Atlantic Ocean from 14° N. to Congo; south of Africa from 55°27′ S. to 64°14′ S.; the tropical Indian Ocean and the Malayan Archipelago. In 1913 the species was mentioned almost simultaneously from the northern Pacific (BIGELOW 1913) and from the Davis Strait (KRAMP 1913). Since that time I have seen numerous specimens from different expeditions in the Atlantic, from which it appears that the species is distributed all over the Atlantic Ocean in deep water. Of these new finding places only: The Atlantic Ocean between 54° and 59°30′ N., 20°40′—26°08′ W. has been published (KRAMP, 1920 b). — The two localities named in the present paper are from the Bay of Biscay and S. W. of Ireland. The specimens still retain a faint hue of the pink colour. The species was exclusively taken in considerable depths. — I cannot here enter on a detailed account of its distribution.

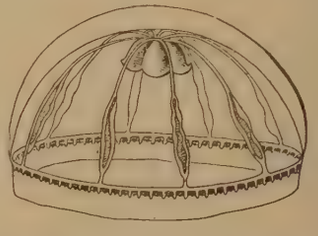


Fig. 19. *Pantachogon rubrum* Vanhöffen. — After Vanhöffen 1902 b (from Mayer 1910).

17. RHOPALONEMA FUNERARIUM Vanhöffen.

(Fig. 20).

non *Dianœa funeraria* Quoy & Gaimard 1827.

Rhopalonema funerarium Vanhöffen 1902 b, p. 61, Taf. IX, fig. 2; Taf. X, fig. 17; Taf. XI, fig. 31.

Rhopalonema coeruleum Maas 1905, p. 51, Taf. X, fig. 67, 68.
partim *Rhopalonema coeruleum* Mayer 1910, p. 380.

Material.

Stat. 181 (06). Lat. 49°22′ N., Long. 12°52′ W. 4. IX. 1906. Depth 1350 m.
Y. 1800 m wire, 7 specimens, diam. 9—17 mm.

Stat. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m wire, 2 specimens, diam. 5—14 mm.

This species has been excellently described and figured by Vanhöffen (1902 b) who identified it with *Dianæa funeraria* Q. & G. — Maas who recognized the species in the material of "Siboga" (1905) doubted the justification of this statement and identified his own as well as Vanhöffen's specimens with *Rh. coeruleum* Haeckel. Later on (1911) Maas has proved "*Dianæa funeraria*" Q. & G. to be a Leptomedusa (see above, *Octocanna funeraria*). Browne (1906, p. 172) recognized *Rh. coeruleum* Haeckel in the Bay of Biscay and gave a new description of it. This species obviously differs from *Rh. funerarium* Vanh. by its distinct apical knot, shorter gonads and the situation of the sensory organs. In all these respects *Rh. coeruleum* approaches *Rh. velatum* Gegenb. Whether it is identical with this latter, as Bigelow thinks (1909, p. 132), or whether they are clearly distinguished species, as maintained by Browne (1916, p. 193—194) I cannot with certainty decide as I have not seen any specimen of *Rh. coeruleum.* It is, however, an established fact that they both differ from *Rh. funerarium* Vanhöffen.

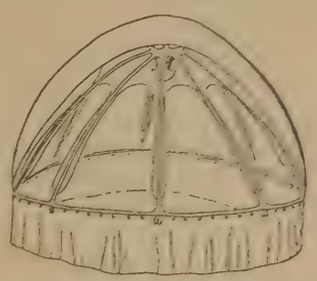


Fig. 20. *Rhopalonema funerarium* Vanhöffen. — After Vanhöffen 1902 b (from Mayer 1910).

Geographical distribution of *Rh. funerarium* Vanh.

The Atlantic Ocean, from Cape Verde Islands to the Benguela Current and further south at ca. 32° S., 10° E.; St. Paul and the warm region of the Indian Ocean (Vanhöffen 1902 b). — The Malay Archipelago (Maas 1905). In the Humboldt Current off the west coast of South America (Bigelow 1909). — In the tropical Atlantic (Vanhöffen 1912 a, p. 372). — *Rh. funerarium* belongs to the intermediate and the deep strata of the great sea depths and are not, or very rarely, to be found in the vicinity of the surface. Now this species has been found by the "Thor" S. W. of Ireland and in the Bay of Cadiz.

The specimens are sufficiently well preserved to be referred without any doubt to *Rh. funerarium* Vanh. which is thus for the first time recorded from the northern Atlantic. In the shape of the bell and length and position of the gonads they perfectly agree with Vanhöffen's excellent figures; the same may be said of the marginal organs. It is true that only in a few cases the sensory organs have been preserved, but these few instances prove that they are placed as in *Rh. funerarium, viz.* midway in the interspaces between the cirri and the tentacles, not as in *Rh. velatum* and *coeruleum* close by the interradial cirrus and the perradial tentacle. The specimens are iridescent but otherwise colourless.

The proportions of height and diameter of the 9 specimens are as follows:

Height:	4	7	10	11	11	11	12	12	12 mm.
Diam.:	5	9	14	15	16	16	17	17	17 —.

18. RHOPALONEMA VELATUM Gegenbaur.

(Fig. 21 and Chart VI).

Material.

Stat. 18. Lat. 37°51′ N., Long. 23°14′ E. 30. XII. 1908.
Y. 300 m wire, 1 specimen, diam. 7 mm.
Stat. 26. Lat. 40°40′ N., Long. 13°59′ E. 19. I. 1909.
Y. 65 m wire, 3 specimens, 5 mm.

Stat. 35. Lat. 43°36′ N., Long. 7°36′ E. 29. I. 1909.
Y. 200 m wire, 25 specimens, 4—9 mm.
Stat. 45. Lat. 37°28′ N., Long. 8°18′ E. 7. II. 1909.
Y. 300 m wire, 13 specimens, 3—7 mm.

Stat. 89. Lat. 36°28′ N., Long. 8°22′ W. 18. VI. 1910.
Y. 1000 m wire, 3 specimens, 4—7 mm.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 300 m wire, 5 specimens, 6—9 mm.
Stat. 116. Lat. 39°27′ N., Long. 5°26′ E. 30. VI. 1910.
Y. 25 m wire, 2 specimens, 4—6 mm.
- 65 - — 44 — 3—7 -
- 300 - — 110 — 4—8 -
Stat. 118. Lat. 41°00′ N., Long. 6°43′ E. 30. VI. 1910.
Y. 65 m wire, 195 specimens, 4—8 mm.
- 300 - — 450 — 4—8 -
Stat. 122. Lat. 43°50′ N., Long. 8°34′ E. 2. VII. 1910.
Y. 1200 m wire, 3 specimens, ca. 9 mm.
Stat. 126. Lat. 42°43′ N., Long. 9°50′ E. 10. VII. 1910.
Y. 300 m wire, 58 specimens, 4—10 mm.
Stat. 129. Lat. 40°05′ N., Long. 11°31′ E. 12. VII. 1910.
Y. 300 m wire, 250 specimens, 4—10 mm.
- 600 - — 36 — 5—9 -
- 1000 - — 31 — 4—9 -
- 3500 - — 9 — 4—7 -
Stat. 131. Lat. 38°36′ N., Long. 11°00 E. 13. VII. 1910.
Y. 300 m wire, 170 specimens, 4—8 mm.
- 1000 - — 5 — 7—8 -
Stat. 132. Lat. 38°57′ N., Long. 9°47′ E. 14. VII. 1910.
Y. 25 m wire, 9 specimens, 6—9 mm.
- 300 - — c.700 — 4—10 -
- 600 - — c.500 — 4—9 -
Stat. 133. Lat. 38°18′ N., Long. 9°59′ E. 14. VII. 1910.
Y. 25 m wire, 4 specimens, ca. 6 mm.
- 300 - — 25 — 5—7 -
- 600 - — 70 — 4—10 -
Stat. 134. Lat. 37°37′ N., Long. 10°17′ E. 15. VII. 1910.
Y. 25 m wire, 4 specimens, c. 5 mm.
- 300 - — c.400 — 4—8 -
Stat. 135. Lat. 37°17′ N., Long. 10°28′ E. 16. VII. 1910.
Y. 25 m wire, 54 specimens, 4—7 mm.
Stat. 137. Lat. 37°17′ N., Long. 10°56′ E. 19. VII. 1910.
Y. 250 m wire, 180 specimens, 3—10 mm.
Stat. 138. Lat. 37°37′ N., Long. 11°25′ E. 19. VII. 1910.
Y. 25 m wire, 4 specimens, 4—7 mm.
- 300 - — c. 350 — 3—9 -
- 1000 - — 32 — 5—9 -
Stat. 139. Lat. 37°57′ N., Long. 11°54′ E. 20. VII. 1910.
Y. 300 m wire, 85 specimens, 3—7 mm.
- 800 - — c. 200 — 5—8 -
Stat. 142. Lat. 35°44′ N., Long. 15°07′ E. 22. VII. 1910.
Y. 150 m wire, 10 specimens, 3—5 mm.
Stat. 143. Lat. 35°18′ N., Long. 16°25′ E. 23. VII. 1910.
Y. 25 m wire, 5 specimens, 5—7 mm.
- 300 - — 77 — 3—8 -
- 1000 - — 24 — 3—6 -
Stat. 144. Lat. 34°31′ N., Long. 18°40′ E. 24. VII. 1910.
Y. 25 m wire, 1 specimen, 4 mm.
- 300 - — 43 — 5—8 -
Stat. 145. Lat. 32°38′ N., Long. 19°02′ E. 25. VII. 1910.
Y. 25 m wire, 3 specimens, 4 mm.
- 300 - — 38 — 5—9 -
Stat. 147. Lat. 31°35′ N., Long. 19°02′ E. 25—26. VII. 1910.
Y. 25 m wire, 9 specimens, 4—7 mm.
- 300 - — 19 — 4—7 -
Stat. 152. Lat. 33°11′ N., Long. 21°44′ E. 27. VII. 1910.
Y. 25 m wire, 3 specimens, 6 mm.
- 300 - — 14 — 5—9 -
Stat. 154. Lat. 32°10′ N., Long. 42°46′ E. 29. VII. 1910.
Y. 300 m wire, 4 specimens, 5—6 mm.
Stat. 156. Lat. 32°24′ N., Long. 26°51′ E. 30. VII. 1910.
Y. 25 m wire, 1 specimen, 5 mm.
- 300 - — 25 — 3—8 -
- 1000 - — 3 — 5—8 -
Stat. 160. Lat. 35°59′ N., Long. 28°14′ E. 1. VIII. 1910.
Y. 300 m wire, 6 specimens, 5—7 mm.
- 1000 - — 7 — 4—10 -
Stat. 163. Lat. 37°52′ N., Long. 26°22′ E. 3. VIII. 1910.
Y. 25 m wire, 3 specimens, 6—8 mm.
- 300 - — 12 — 4—6 -
- 1000 - — 10 — 5—10 -
Stat. 179. Lat. 40°02′ N., Long. 25°55′ E. 13. VIII. 1910.
Y. 65 m wire, 44 specimens, 4—6 mm.
Stat. 182. Lat. 38°13′ N., Long. 24°48′ E. 13. VIII. 1910.
Y. 600 m wire, 4 specimens, 4—5 mm.
Stat. 183. Lat. 37°52′ N., Long. 23°09′ E. 16. VIII. 1910.
Y. 65 m wire, 10 specimens, 5—6 mm.
- 300 - — 4 — 6—8 -
Stat. 190. Lat. 37°51′ N., Long. 15°19′ E. 19. VIII. 1910.
Y. 25 m wire, 31 specimens, 3—8 mm mostly small.
Stat. 192. Lat. 38°07′ N., Long. 15°35′ E. 20. VIII. 1910.
Y. 300 m wire, 7 specimens, 5—8 mm.
Stat. 193. Lat. 38°15′ N., Long. 15°39′ E. 21. VIII. 1910.
Y. 10 m wire, 2 specimens, 4 mm.
Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 25 m wire, 15 specimens, 3—7 mm mostly small.
- 1200 - — 37 — 3—7 -
Stat. 195. Lat. 39°02′ N., Long. 14°55′ E. 21. VIII. 1910.
Y. 65 m wire, 6 specimens, 3—6 mm.
Stat. 197. Lat. 40°34′ N. Long. 13°36′ E. 24. VIII. 1910.
Y. 300 m wire, 2 specimens, ca. 6 mm.
Stat. 199. Lat. 39°32′ N., Long. 10°49′ E. 25. VIII. 1910.
Y. 25 m wire, 11 specimens, 4—8 mm.
- 300 - — c. 350 — 3—9 -
- 1000 - — 84 — 3—11 -
Stat. 200. Lat. 39°18′ N., Long. 10°11′ E. 26. VIII. 1910.
Y. 25 m wire, 10 specimens, 5—7 mm.
Stat. 202. Lat. 38°59′ N., Long. 9°25′ E. 26. VIII. 1910.
Y. 300 m wire, ca. 280 specimens, 4—9 mm.
Stat. 204. Lat. 38°52′ N., Long. 7°43′ E. 27. VIII. 1910.
Y. 65 m wire, 3 specimens, 7—9 mm.
- 300 - — 74 — 5—8 -
- 1000 - — 8 — 5—10 -
Stat. 205. Lat. 39°16′ N., Long. 5°52′ E. 27. VIII. 1910.
Y. 25 m wire, ca. 250 specimens, 4—6 mm.
Stat. 206. Lat. 39°32′ N., Long. 5°15′ E. 28. VIII. 1910.
Y. 300 m wire, 265 specimens, 3—7 mm.
- 1000 - — 46 — 5—9 -
- 2000 - — 66 — 5—9 -
Stat. 207. Lat. 39°58′ N., Long. 3°41′ E. 28. VIII. 1910.
Y. 25 m wire, 29 specimens, 4—6 mm.
- 65 - — 9 — 3—6 -
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Ringtrawl, vertical haul 75—35 m, 11 specimens 3—6 mm.

Y. 100 m wire, ca. 65 specimens, 3—6 mm.
- 150 m wire, 71 specimens, 4—8 mm, mostly small.
Y. 300 m wire, ca. 260 specimens, 4—9 mm, mostly large.
Y. 1000 m wire, 52 specimens, 5—9 mm, mostly large.
- 2000 m wire, 47 specimens, 5—9 mm.

Stat. 210. Lat. 41°10′ N., Long. 2°23′ E. 30. VIII. 1910.
Y. 600 m wire, 21 specimens, 6—12 mm.

Material collected by Captain G. HANSEN in the Strait of Messina 1911, all hauls with 1 m ringtrawl:

Stat. 278. 2 miles E. of Messina lighthouse. 22. II. 1911.
15 m wire, 12 specimens, 4—6 mm.

Stat. 280. 1 mile E.S.E. of Messina lighthouse. 25. II. 1911.
15 m wire, 2 specimens, 5 mm.

Stat. 282. Between Messina lighthouse and San Giovanni, in the middle of the Strait. 8. III. 1911.
40 m wire, 3 specimens, 5 mm.

Stat. 283 a. Between Messina and San Giovanni, in the middle of the Strait. 12. III. 1911.
40 m wire, 4 specimens, 4—5 mm.

Stat. 283 b. Between Messina and San Giovanni, nearest by Sicily. 13. III. 1911.
40 m wire, 3 specimens, 4—6 mm.

Further Distribution.

The Mediterranean: The Strait of Gibraltar (CARUS 1884, p. 35, *Marmanema tympanum*) — ?Nice (LEUCKART; CARUS 1884, p. 35, *Marmanema umbilicatum*). — Naples (MAYER 1910, p. 378). Round Capri, almost everywhere, at the surface as well as in the depth (LOBIANCO 1903—04, p. 217 and 1904, p. 55). Messina (GEGENBAUR; CARUS 1884, p. 35 & 36; *Trachynema ciliatum, Rhopalonema velatum*). Corfu (HAECKEL; CARUS 1884, p. 36). Several places at the Dalmatian coast (NEPPI 1912, p. 730). Trieste, in February, rarely (NEPPI & STIASNY 1913, p. 57).

Outside of the Mediterranean: Widely distributed in the warm parts of all the oceans (MAAS 1893, p. 14; 1904 a, p. 27; 1905, p. 50. VANHÖFFEN 1902 b, p. 59; 1912 a, p. 371; 1912 b, p. 29. BROWNE 1916, p. 193. BIGELOW 1909, p. 129; 1918, p. 388; 1919, p. 323). Also in the southern Atlantic (VANHÖFFEN 1912 a, p. 371).

Fig. 21. *Rhopalonema velatum* Gegenbaur. From Mayer 1910.

After having examined specimens from the Bay of Biscay and the northern Atlantic I feel convinced that the specimens from the Bay of Biscay, referred by BROWNE (1906) to *Rh. coeruleum* Haeckel, really do belong to *Rh. velatum* as supposed by BIGELOW. At any rate, I do not doubt that the specimens which were collected by the "Thor" and "Michael Sars" S. W. of Ireland and W. of Scotland belong to the typical *Rh. velatum* which thus is distributed much further north in the Atlantic than formerly believed.

It has several times been emphasized (MAYER, BIGELOW a. o.) that *Rh. velatum* is a surface form of the oceans, and that only in the Mediterranean it goes down to deeper strata. During the Atlantic Expedition of the "Michael Sars" 1910 the species was, however, in several places taken in considerable depths.

On the expeditions of which the material is discussed in the present paper *Rh. velatum*, except for a single find in the Bay of Cadiz, was exclusively taken in the Mediterranean; I shall, therefore, not enter on a discussion of its occurrence in the Atlantic ocean. The material from the Mediterranean, on the other side, is very rich; *Rh. velatum* appears to be exceedingly numerous and widely distributed in the Mediterranean, it is perhaps the most common of all the medusæ of this sea. There is, therefore, every reason to make the occurrence and appearance of this species subject to a somewhat more detailed account.

Rh. velatum is distributed all over the Mediterranean from the Strait of Gibraltar to the Dardanelles but has not been found as yet in the Sea of Marmora. In the Levant it has been collected as far as to Rhodes, but there is nothing to prevent us from expecting it to occur even to the coast of Palestine. It is a totally oceanic form; its occurrence is independent of the vicinity of the coast, and we consequently find it in the Mediterranean in the middle of the open basins as well as in the neighbourhood of the coasts.

From the Adriatic Sea we only know it from the literature. NEPPI found it in several places off

the coast of Dalmatia in June and July, but it is only in the southern part of the examined area that it is common; at Trieste it only seldom occurs (February, NEPPI & STIASNY 1913).

HAECKEL has found it in the Strait of Gibraltar, but here and in the nearest neighbourhood it seems to be rare. Though the "Thor" has examined this area at different seasons, *Rh. velatum* was never found in the Strait of Gibraltar and only a single time in the Alboran Sea, at stat. 106, which is close by the Spanish coast, 25. VI. 1910, at a time when the circulating intermediate volumes of water (Mediterranean water) were relatively powerful and, at any rate in the northern part of the Alboran Sea, moving westwards (see NIELSEN 1913, p. 158). — On the other hand, it was missing all along the coast of Algeria, but east of a line drawn from Barcelona across the Balearic Islands to the north coast of Tunis it was, so to speak, everywhere to be found.

The summary below (table II) is specially meant as an illustration of the vertical distribution, and at the same time of the size of the individuals at different seasons. The number of specimens stated

Table II. *Rhopalonema velatum*. Average number of individuals per 60 minutes' haul with young-fish trawl (Y 200) at different seasons and in different depths.

m wire	Western Basin 19. I—7. II (1909) Stat. 26—45		Western Basin 30. VI—20. VII (1910) Stat. 116—139		Eastern Basin 22. VII—1. VIII (1910) Stat. 142—160		Ægean Sea 3.—16. VIII (1910) Stat. 163—183		Western Basin 21.—30. VIII (1910) Stat. 194—210	
	number	size, mm	number	size, mm	number	size, mm	number	size, mm	number	size, mm
10	..	..	..	..	..	..	0	..	0	..
25	..	..	5	4—9	8	4—7	12	6—8	141 (18)	3—8
65—150	3	5	239	3—8	20	3—5	43	4—6	77	3—9
200—300	26	3—9	506	3—10	57	3—9	32	4—8	632	3—9
600—800	..	..	282	4—10	..	..	8	4—5	42	6—12
1000—1200	..	..	19	4—9	7	3—10	20	5—10	78	3—11
2000	..	..	..	..	0	..	..	..	76	5—9
3500	..	..	5	4—7	..	..	..	..	..	..

in the summary indicates the average number of individuals per 60 minutes' haul with young-fish trawl (Y. 200); where a haul lasted more or less than 60 minutes the actual number of specimens taken has been multiplied so as to correspond to the number per 60 minutes' haul. Hauls with Y 200 of a negative result have also been entered in the calculation, insomuch as the species was altogether found at the station concerned. This does of course influence the average numbers stated, the total number of specimens from a certain depth inside of a series of stations being divided with the total number of hauls, even if *Rhopalonema* were not found in them all. I have calculated the figures within the more extensive geographical areas separately and from different seasons. Excepted from the calculation are the following stations: 106 (the isolated occurrence in the Alboran Sea), 190—193 in the Strait of Messina, the particular current circumstances in the narrow strait effecting peculiar and irregular facts (it is f. inst. the only place where *Rhopalonema* has been taken with 10 m wire out); stat. 135 and 207 both being less than 200 m deep (see below). We shall now proceed to a discussion of the summary.

From the winter months we have unfortunately only very few investigations to refer to, still enough to prove that *Rhopalonema* was very scanty in the western basin in January—February compared with the great numbers which were collected during the summer months. As to the collections from the summer we will first notice the fact that the species is much more frequent in the western than in the eastern basin and the Ægean Sea. — All over the Mediterranean proper we find the greatest number of specimens to have been taken in hauls with 300 m wire out (ca. 200 m below the surface), and that they are

then decreasing in number both downwards and upwards. The species has been collected as far down as ca. 2000 m below the surface; only in August 1910 young-fish trawl with 10 m wire (at the surface) has been used; the species was never taken by these hauls. The relatively high average number stated in the summary for hauls with 25 m wire out in the western basin, in the end of August, is due to the haul at stat. 205 (midway between Sardinia and the Baleares) which produced a very great number of *Rhopalonema* (1000 per haul of 1 hour); this is most extraordinary as no specimens at all were found in the same depth at stat. 204 and 206. It is rather difficult to make any conjectures concerning the reason of this phenomenon, as no hydrographical investigations have been made at stat. 205. As, moreover, this one plankton haul was the only one made, we do not know whether *Rhopalonema* may have been especially abundant also in the deeper strata of this very great depth (ca. 2860 m). Provided that stat. 205 is excepted from the calculation, the average number of *Rhopalonema* per hour, with 25 m wire, is reduced to 18 (placed in brackets in table II). The fact that this species was not taken by the collections of the "Pangan" in 1911—12 certainly is due to the fishing not having been undertaken at sufficiently great depths.

Chart VI. ● Finds of *Rhopalonema velatum* Ggb., ○ occurrence in the Mediterranean according to the literature.

At the two stations in the western basin, stat. 135 (near Tunis) and 207 (between the Baleares), which are both inside of the 200 m curve, a considerably larger number of *Rhopalonema* was taken with 25 m wire out than at the same depth in other, neighbouring stations. At stat. 207 a haul with 65 m wire out was also made; it only produced $^1/_3$ of the number of specimens from the haul with 25 m wire out. These two stations thus provide us with the proof that *Rhopalonema*, which is otherwise chiefly living at a depth of ca. 200 m, rises to higher water layers in the vicinity of the coasts. — A similar fact we meet with in the Ægean Sea. The stations here are too few and too varied for giving a reliable illustration of the circumstances, generally spoken. When I have, nevertheless, included this area in the summary, it is mostly in order to demonstrate the size of the specimens. — From July 22.—Aug. 1. *Rhopalonema velatum* was collected at 4 stations in the Ægean Sea: at stat. 163 (depth 1170 m) the greatest number of specimens was taken with 300 m wire out; at stat. 182 (500 m) only a few specimens were taken with 600 m wire out, none further upwards; on the other hand, the species was taken rather numerously at stat. 179 at the entrance to the Dardanelles (depth 85 m) by a haul with 65 m wire out. At stat. 183, near Corinth, (233 m) there were more specimens in hauls with 65 m wire than in those with 300 m wire out.

The peculiarity that *Rhopalonema*, which was so very numerous east and north of the Baleares at the end of August 1910, was not found south of these islands or in the Alboran Sea the following days, shall be discussed in the General Part.

As regards the size of the individuals, the summary proves that both small and large specimens may be found everywhere, in all areas, in all depths, and in winter as well as in summer. This does, however, not mean that the different size groups are distributed quite homogeneously, according to time and space, but the differences present only become evident when each station is studied separately.

I must therefore refer to the list of the material. Then we shall see that there are mainly small individuals in the upper water layers, whilst larger ones are predominant in the intermediate and deeper strata; this is particularly obvious at stat. 209, but at several other stations, f. inst. stat. 116, 133, 134, 138, 156, 199, 206 etc., there is an indication of corresponding circumstances. Very large individuals of 11—12 mm diam. only were collected with 600 m wire and in still greater depths.

Small individuals (3—4 mm diam.) having been collected at all the seasons from which investigations are at hand, breeding cannot be limited to a certain fixed season. The great number of, especially middle-sized, individuals in July—Aug. in proportion to the scanty number in the winter still seems to indicate that breeding must have a maximum at a certain time of the year. The following questions now arise: At what season is the breeding at its maximum? At what rate do the individuals grow? Are one or more generations developed in the course of a year?

We must take it for granted that fullgrown individuals are numerous at the time of the year when the breeding is at its maximum. In Captain HANSEN's collections from the Strait of Messina in Febr.—March 1911 *Rhopalonema* was rather scarce, and no individuals were more than 6 mm in diameter. At the investigations of Jan.—Febr. 1909 the species also was scanty in number, with yet a few larger individuals up to 9 mm in diam. In July and August the species is very numerous, as we have seen, but the middle-sized, not fully mature individuals still exceed the fullgrown in number. It therefore is an obvious conclusion that the maximum of breeding occurs in the last part of summer or in autumn, after which the majority of the large individuals die. If the individuals grow quickly we then might expect to find them in considerable numbers in the winter, but this is not so. If they grow slowly the young medusæ ought to be numerous in the winter; their not being found may be due to the implements applied. There is no reason to suppose that the individuals should grow more slowly in winter than in summer, for in the depths where the species mainly lives, the temperature of the water is higher in the winter than in the summer. I am rather inclined to think that the development and lifetime of the individuals take up about a year, and that the breeding which takes place all the year round has a maximum reaching through all the summer and autumn.

19. COLOBONEMA SERICEUM Vanhöffen.

(Fig. 22).

Material.

Stat. 181 (06). Lat. 49°22′ N., Long. 12°52′ W. 4. IX. 1906. Depth 1350 m. | Y. 1800 m wire, 3 specimens.

It is absolutely precluded that *Homoeonema typicum* Maas (1897, p. 22, Taf. 3, figs. 1—3) may be identic with *Colobonema sericeum* Vanh. MAYER (1910, p. 385) considers *H. typicum* to be a younger specimen, but as it has not only most well-developed gonads but also a much greater number of tentacles, this supposition seems to be rather unlikely. The bell, moreover, is of a much lower shape and the gonads far more short. It is, however, probable that the specimens from the "Siboga" Expedition (*Colobonema typicum*, Maas 1905, p. 53, Taf. 10, figs. 62—65) belong to *C. sericeum*, although also here the shape of the bell is somewhat deviating. I have seen several preserved specimens of *Colobonema sericeum* and has observed the firm consistency of the umbrella; the shape will keep astonishingly well and the bell hardly ever collapses as in most of the similar forms. The bell makes the impression of being somewhat conical; the exumbrella is, however, evenly rounded (see fig. 22), but the mesogloea is thicker on the sides than at the apex and then tapering towards the margin of the bell, whereby the subumbrella, which is easily conspicuous on account of its very strong muscles,

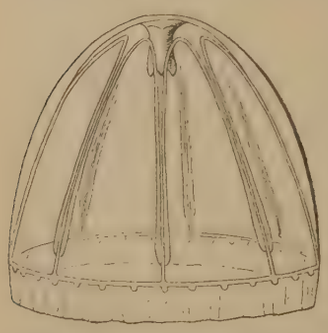


Fig. 22. *Colobonema sericeum* Vanhöffen. — After Vanhöffen 1902 b (from Mayer 1910).

becomes conical. — As most of the specimens I have seen belong to a material which has not been published I cannot now enter on a discussion of eventual variability. I shall be content to say that the three specimens at hand confirm MAAS's statement (1905) of the peculiar succession in the development of the tentacles, the constancy of which was emphasized by BIGELOW (1909).

Geographical Distribution.

Several places in the eastern tropical Pacific (BIGELOW 1909, p. 133, *Colobonema sericeum*). — Malay Archipelago (MAAS 1905, p. 53, *Colobonema typicum*). — The Indian Ocean, from 9° N. to 34° S. (VANHÖFFEN 1902 b, p. 57, *C. sericeum*). — The Atlantic, from 42° S. to 2° N. (VANHÖFFEN, ibid.). — The South-Atlantic, tropical Atlantic, and N. W. of Cape Verde Islands (VANHÖFFEN 1912 a, p. 372). — Bay of Biscay, 1 specimen (BROWNE 1906, p. 172). — The North-Atlantic ca. 54° N. 26° W. (KRAMP 1920 b, p. 5). — The medusa was everywhere taken in considerable depths.

The species evidently may be met with anywhere in the depth of the Atlantic to the submarine ridge of Scotland— Iceland—Greenland. Zoological Museum of Copenhagen possesses specimens from the Rockall Channel and from S. W. and W. of Iceland.

20. HOMOEONEMA CONICA (Vanhöffen).

(Fig. 23).

Haliscera conica Vanhöffen 1902 b, p. 72. Taf. IX, fig. 6, Taf. XI, fig. 33.

Material.

Stat. 39. Lat. 39°41′ N., Long. 10°02′ E. 1. II. 1909.
Y. 1000 m wire, 1 specimen, diam. ca. 6 mm, height ca. 5 mm.

Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Y. 2000 m wire, 3 specimens, diam. ca. 7—ca. 9 mm.

In the material from the Mediterranean are found the above 4 specimens of a Halicreaside which presumably belongs to *Homoeonema conica*, hitherto only known from the Indian Ocean. The three specimens from Stat. 209 are very badly preserved, the one from stat. 39 is not in good condition either, but the shape, the number of tentacles (ca. 7—8 per octant) and the position of the gonads on the centre of the radial canals are in good agreement with the fine figures and, unfortunately, very brief description of VANHÖFFEN. *H. alba* (Vanh.) has the gonads in much closer vicinity of the stomach, and *H. glabrum* and *rotundatum* are said to have a much larger number of tentacles. The specimens from the Mediterranean furthermore agree with a Halicreaside from the waters west of the British Islands which I have seen in the material from the Atlantic Expedition of the "Michael Sars" 1910, and which I should think, on account of its better preservation, might without doubt be referred to *H. conica*.

Fig. 23. *Homoeonema conica* (Vanhöffen). — After Vanhöffen 1902 b (from Mayer 1910).

21. AGLANTHA DIGITALE (O. Fr. Müller).

(Fig. 24).

Material.

Stat. 61. Lat. 35°57′ N., Long. 5°35′ W. 21. II. 1909.
Y. 65 m wire, 2 specimens, height 13—16 mm.
Stat. 76. Lat. 47°01′ N., Long. 5°48′ W. 10. III. 1909.
Y. 65 m wire, 10 specimens, height 11—14 mm.
- 300 - — 24 — — 10—17 -
Stat. 95. Lat. 35°57′ N., Long. 6°00′ W. 23. VI. 1910.
Y. 300 m wire, 2 specimens, height 14 mm.

Stat. 246. Lat. 48°02′ N., Long. 5°23′ W. 18. IX. 1910.
Y. 100 m wire, 420 specimens, height 5—10 mm.
Stat. 247. Lat. 48°43′ N., Long. 4°45′ W. 19. IX. 1910.
Y. 65 m wire, 72 specimens, height 5—10 mm.
Stat. 181 (06). Lat. 49°22′ N., Long. 12°52′ W. 4. IX. 1906.
Y. 1800 m wire, 4 specimens, height 11, 13, 14, 18 mm.

This widely distributed and wellknown medusa is common everywhere in the north-atlantic area and in the arctic oceans, both in the vicinity of the coasts and far out in the open sea. As a rule, it is not common close by the surface, but has its maximal occurrence some way below it; on the other hand, it may descend to considerable depths. The find of some individuals at stat. 181 (1906) by a haul with 1800 m wire, therefore, is no excëption. In the depth the individuals generally obtain a considerable size and stronger muscles than the specimens from the upper strata. — At the coasts of Europe *Aglantha digitale*, as far as I know, has not hitherto been found further south than the Bay of Biscay, It is, therefore, interesting that the "Thor" has taken some specimens at two stations in the Strait of Gibraltar: stat. 61 in February 1909 and stat. 95 in June 1910. It is not only this that these two localities are situated much further south than the species was hitherto known to be distributed in the Atlantic, but the find of 2 specimens not far from the surface (65 m wire out) in the middle of the very Strait of Gibraltar (stat. 61) almost indicates an attempt of entering the Mediterranean, where the species was, however, never found as yet.

Fig. 24. *Aglantha digitale* (O. F. Müller).

Genus LIRIOPE.

The great number of more or less badly defined species into which the genus *Liriope* has been divided has been the cause of many difficulties to the medusologists. The differences which serve to separate the species are generally very slight, and the characters are subject to a considerable variation within the separate species. Mayer (1910) divides the species into three groups according to the shape of the gonads, but even to one of these groups it may be difficult to make any referment; it is not always easy to decide whether the gonads be cordate, triangular or oval.

In the great material of *Liriope* from the "Thor"-Expeditions I mean to be able to recognize 3 species: *eurybia* Hckl.. *exigua* Q. & G., and *mucronata* Gegenb.

Mayer (1910, p. 416) indicates *L. mucronata* as "the common *Liriope* of the Mediterranean". The paramount number of *Liriope* in the material of the "Thor", however, has oval gonads, about double as long as broad and without any trace of a cordate base, and does certainly belong to *L. eurybia* Hckl. On the other hand, in samples from the south-coast of Spain I have found 3 specimens of *Liriope* with broad, conspicuously cordate gonads; in two of these specimens the gonads almost reach to the circular vessel, wherefore I have referred them to *L. mucronata*; in the third specimen the gonads are separated from the circular vessel by a distance which is almost $^2/_3$ of the length of the gonads, and consequently I have referred this specimen to *L. exigua*. — All three species are hitherto known from the Mediterranean.

22. LIRIOPE EXIGUA (Quoy & Gaimard).

(Fig. 25).

Material.

Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 1 specimen.

The individual is rather strongly contracted; its diameter in its present condition 7 mm, height 5 mm; the apical jelly greatly shrunk. The greatest width of the gonads, 2.5 mm, equals the length; they are conspicuously cordate, and they are the widest close by their proximal part. The distance from the distal part of the gonads to the circular vessel is ca. 1.5 mm. The gonads contain well-developed eggs. In each quadrant there are three centripetal canals of some length.

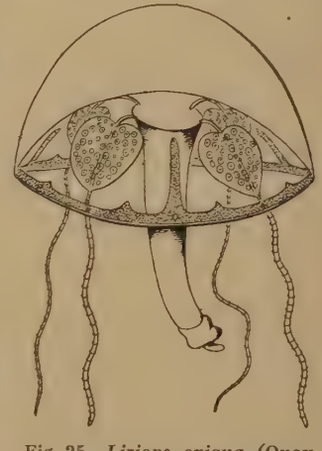


Fig. 25. *Liriope exigua* (Quoy & Gaimard). — After Maas 1893 (from Mayer 1910).

Further Distribution.

The Mediterranean: The Strait of Gibraltar (Quoy & Gaimard; Carus 1884, p. 38, *L. cerasiformis*). ?Naples, in winter, mature Dec.—May (Lobianco 1888, p. 388, *L. exigua*). — The warm parts of the Atlantic; if *L. appendiculata* is identic with *exigua* its distribution reaches as far as to the British Islands.

Mayer (1910) considers *L. mucronata* to be a Mediterranean variety of *L. exigua*; the typical form then would belong to the Atlantic. — The only specimen which was collected by the "Thor" was found in the Alboran Sea, close by the Spanish coast in the upper water layers.

23. LIRIOPE MUCRONATA Gegenbaur.

(Fig. 26).

Material.

Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 65 m wire, 1 specimen.

Stat. 107. Lat. 36°18′ N., Long. 1°14′ W. 25. VI. 1910.
Y. 65 m wire, 1 specimen.

The individual from stat. 106 is 5 mm wide and 3 mm high, of which the apical jelly ca. 1.5 mm. The gonads (♂) are ca. 1.3 mm long, 1 mm broad; their base is cordately incised, but the lateral margins are almost parallel, slightly converging towards the bell margin till they make a rather sudden inwards curve towards the radial canal with their distal part. The gonads almost touch the circular vessel, and the short part of the radial canals separating it from the latter is very broad, ca. $^2/_3$ of the breadth of the gonads. The interradial centripetal canal in each quadrant is broad and rather long, the adradial just founded.

The specimen from stat. 107 is somewhat larger, its diameter being 8 mm, its height 5 mm of which the apical jelly constitutes about one half. The gonads (♀) are 2 mm long, $1^3/_4$ mm broad; they have a typically cordate base, but the greatest breadth is only a little proximal to the middle. Its relation to the circular vessel is as in the other individual. The adradial centripetal canals are only very little more developed than in the above individual.

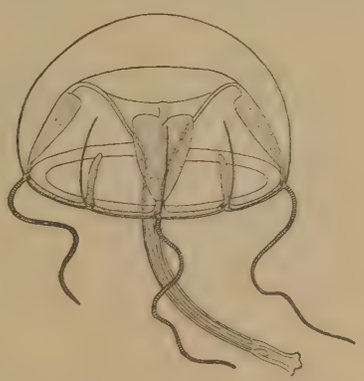


Fig. 26. *Liriope mucronata* Gegenbaur. — From Mayer 1910.

Further Distribution.

Mayer (1910), as above mentioned, indicates this species as "the common Liriope of the Mediterranean", stating it to be common at Naples all the year round. Metschnikoff (1886, p. 10) identifies it with *L. eurybia* Haeckel, stating as finding places Villefranche, Naples and Messina. In the rest of the literature concerning medusæ from the Mediterranean it is only stated from Messina (Gegenbaur, Sars, Keferstein & Ehlers; Carus 1884, p. 37, *Liriantha mucronata*).

The "Thor" has only collected this species in the Alboran Sea.

24. LIRIOPE EURYBIA Haeckel.

(Fig. 27 and Chart VII).

Syn. *Geryonia exigua* Leuckart 1856 (sec. Mayer).

Material.

Stat. 85. Lat. 38°22′ N., Long. 9°28′ W. 17. VI. 1910.
Ringtrawl, surface, 4 specimens, diam. 5—7 mm.
Y. 65 m wire, 38 specimens, 4—10 mm.
Stat. 94. Lat. 36°06′ N., Long. 6°02′ W. 23. VI. 1910.
Y. 65 m wire, 3 specimens, 4—5 mm.

Stat. 96. Lat. 35°48′ N., Long. 5°58′ W. 23. VI. 1910.
Y. 65 m wire, 4 specimens, middlesized.
Stat. 105. Lat. 36°43′ N., Long. 2°08′ W. 24. VI. 1910.
Y. 40 m wire, 1 specimen, 4 mm.

Stat. 107. Lat. 36°18′ N., Long. 1°14′ W. 25. VI. 1910.
Y. 65 m wire, 7 specimens, 6—8 mm. (1 specimen of 8 mm diam. is six-rayed, otherwise normal, only one of the gonads is smaller than the others.)
Y. 300 m wire, 4 specimens, 5—6 mm.
Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 25. VI. 1910.
Y. 25 m wire, 1 specimen, 4 mm.
- 65 - — 1 — 4 -
Stat. 129. Lat. 40°05′ N., Long. 11°31′ E. 12. VII. 1910.
Y. 25 m wire, 1 specimen, 4 mm.
Stat. 142. Lat. 35°44′ N., Long. 15°07′ E. 22. VII. 1910.
Y. 25 m wire, 16 specimens, 4—6 mm.
- 150 - — 5 — 3.5—7 mm.
Stat. 144. Lat. 34°31′ N., Long. 18°40′ E. 24. VII. 1910.
Y. 25 m wire, 1 specimen, 5 mm.
Stat. 145. Lat. 32°38′ N., Long. 19°02′ E. 25. VII. 1910.
Y. 25 m wire, 9 specimens, 3—6 mm.
Stat. 147. Lat. 31°35′ N., Long. 19°02′ E. 25.-26.VII. 1910.
Y. 25 m wire, 37 specimens, 4—7 mm.
- 300 - — 3 — 4 -
- 1000 - — 4 — 5—6 -
Stat. 152. Lat. 33°11′ N., Long. 21°44′ E. 27. VII. 1910.
Y. 25 m wire, 2 specimens, 5 mm.
Stat. 154. Lat. 32°10′ N., Long. 24°46′ E. 29. VII. 1910.
Y. 25 m wire, 1 specimen, 5 mm.
Stat. 156. Lat. 32°24′ N., Long. 26°51′ E. 30. VII. 1910.
Y. 25 m wire, 1 specimen, 5 mm.
Stat. 160. Lat. 35°59′ N., Long. 28°14′ E. 1. VIII. 1910.
Y. 25 m wire, 25 specimens, 2—4 mm.
Stat. 161. Lat. 36°12′ N., Long. 27°16′ E. 2. VIII. 1910.
Y. 25 m wire, 19 specimens, 3—5 mm.
Stat. 174. Lat. 40°54′ N., Long. 28°53′ E. 11. VIII. 1910.
Y. 65 m wire, ca. 300 specimens, 2—5 mm.
Stat. 175. Lat. 40°48′ N., Long. 27°59′ E. 11. VIII. 1910.
Y. 35 m wire, many thousand specimens, 2—7 mm.
- 100 - — 133 specimens, 3—7 mm.
- 400 - — 300 — 3—6 -
- 1200 - — 500 — 2—5 -
Stat. 176. Lat. 40°45′ N., Long. 27°43′ E. 12. VIII. 1910.
Y. 65 m wire, ca. 300 specimens, 3—5 mm.
Stat. 178. Lat. 40°16′ N., Long. 26°32′ E. 12. VIII. 1910.
Y. 10 m wire, 88 specimens, 2—5 mm.
- 65 - — ca. 500 — 3—8 -
Stat. 179. Lat. 40°02′ N., Long. 25°55′ E. 13. VIII. 1910.
Y. 65 m wire, 2 specimens, 6—7 mm.
Stat. 182. Lat. 38°13′ N., Long. 24°48′ E. 13. VIII. 1910.
Y. 600 m wire, 1 specimen, small.
Stat. 183. Lat. 37°52′ N., Long. 23°09′ E. 16. VIII. 1910.
Y. 65 m wire, 9 specimens of which 1 sp. 12 mm, the rest 4—6 mm.
Y. 300 m wire, 4 specimens, 6 mm.
Stat. 192. Lat. 38°07′ N., Long. 15°35′ E. 20. VIII. 1910.
Y. 25 m wire, 32 specimens, 4—8 mm.
Stat. 193. Lat. 38°15′ N., Long. 15°39′ E. 21. VIII. 1910.
Y. 10 m wire, 1 specimen, 5 mm.
Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 25 m wire, 4 specimens, 4—6 mm.
Stat. 197. Lat. 40°34′ N., Long. 13°36′ E. 24. VIII. 1910.
Y. 25 m wire, 19 specimens, 5—7 mm.
Stat. 199. Lat. 39°32′ N., Long. 10°49′ E. 25. VIII. 1910.
Y. 25 m wire, 5 specimens, 4—7 mm.
- 300 - — 1 — 7 -
Stat. 200. Lat. 39°18′ N., Long. 10°11′ E. 26. VIII. 1910.
Y. 25 m wire, 51 specimens, 3—7 mm.
Stat. 210. Lat. 41°10′ N., Long. 2°23′ E. 30. VIII. 1910.
Y. 25 m wire, 3 specimens, 4, 4, 7 mm.

Collected by Captain G. Hansen in the Strait of Messina 1911, all with 1 m ringtrawl:

Stat. 278. 2 miles E. of Messina lighthouse. 22. II. 1911.
15 m wire, 12 specimens, 4—6 mm.
Stat. 280. 1 mile E.S.E. of Messina lighthouse. 25. II. 1911.
15 m wire, 2 specimens, ca. 5 mm.
Stat. 281. Between Messina lighthouse and Faro. 1. III. 1911.
40 m wire, 3 specimens, 4—5 mm.
Stat. 282. Between Messina lighthouse and St. Giovanni, in the middle of the Strait. 8. III. 1911.
40 m wire, 33 specimens, 4—5 mm.
Stat. 283 a. Between Messina lighthouse and St. Giovanni, in the middle of the Strait. 12. III. 1911.
40 m wire, 23 specimens, 4—7 mm.
Stat. 283 b. Between Messina lighthouse and St. Giovanni, nearest by Sicily. 13. III. 1911.
40 m wire, 14 specimens, 4—5 mm.

"Pangan" 1911.

Stat. 340. Lat. 35°50′ N., Long. 21°30′ E. 26. VIII. 1911.
2 m ringtrawl, 28 m wire, 24 specimens, 3—6 mm.
1.5 m ringtrawl, 108 m wire, 11 specimens, 3—5 mm.

Further Distribution.

The Mediterranean: Nice, Genoa, Naples (Carus 1884, p. 38, *L. eurybia*). S. and W. of Capri in February and March (Lobianco 1903, p. 218). — Trieste, frequent in autumn and winter, young specimens in Oct.—Nov., mature in the winther months (Graeffe 1884, p. 28; Neppi & Stiasny 1913, p. 58). — In several places off the coast of Dalmatia in June—Aug., mostly young individuals (Neppi 1912, p. 731). — Mayer states it to be common in the Mediterranean.

Further commonly distributed in the tropical Atlantic, especially in the Sargasso Sea, yet also in the Florida-Current and the northern Equatorial Current (Maas 1893).

The literature as well as the material of the "Thor" prove this species to be distributed all over the Mediterranean and adjacent inside waters from the Strait of Gibraltar to the Bosphorus, close by the shore as well as in the open sea. Still on the expeditions of the "Thor" it was missing in the Balearic Sea, but was found in the Alboran Sea and rather abundantly in the Tyrrhenian Sea; in the eastern basin it was found almost anywhere (see Chart VII).

Fig. 27. *Liriope eurybia* Haeckel. — After Maas 1893 (from Mayer 1910).

Vertical Distribution. *L. eurybia* was mainly taken in hauls with 25—65 m wire out, *i. e.* it keeps to the upper strata between 15 and 50 m (or a little more) below the surface. At the surface proper it has only been taken in the Strait of Messina (stat. 193) and the Dardanelles (stat. 178) offering special current conditions. In greater depths it was likewise only rarely met with: at stat. 107 (the Alboran Sea), 183 (the Ægean Sea) and 199 (the Tyrrhenian Sea) some few specimens were taken with 300 m wire out, and at stat. 182 (the Ægean Sea) an individual was taken with 600 m wire out. In two cases (stat. 147, Sidra Sea, and 175, Sea of Marmora, see list) the species was apparently taken in still greater depths, but in both cases it is the most probable that the individuals from the deep hauls were in reality caught while the implement was being hauled through the upper strata. This is the more likely at stat. 175 where a haul of 15 minutes with 35 m wire produced many thousand *Liriope*; it therefore is most probable that the young-fish trawl being hauled up from the depth may catch some hundreds on its way upwards through this dense shoal.

The occurrence of an enormous multitude of *Liriope* in the Sea of Marmora is an astonishing fact. Whether this sea offers especially good opportunities to the rearing of this medusa, or the big shoals are carried in from the Ægean Sea, this accumulation means that the Sea of Marmora must act as a trap from which the medusæ are more or less prevented from getting out either to the Black Sea or to the Ægean Sea (only 2 individuals were found at stat. 179). As we have seen, enormous quantities of *Liriope* were found at stat. 175 in a depth of ca. 20 m, but a haul with the same big implement (Y. 200) with 10 m wire out did not take a single individual. The mighty accumulation needs, however, a more detailed explanation. We shall look closer into this matter in the General Part.

Chart VII. ● Finds of *Liriope eurybia* Hckl., ○ occurrence in the Mediterranean according to the literature.

If this species develops in the same way as *L. mucronata* (the development of which has been studied by Metschnikoff), a pelagic "Actinula" larva appears from the egg of the medusa and is later directly developed into a medusa. As the medusa was totally missing in the examined areas of the expedition of the "Thor" in the winter (1908—09) it might be concluded that the species in winter time

is represented in the plankton by the Actinula stage, that the larvæ in the course of spring develop into medusæ which grow and at last breed in autumn and disappear. It is, however, a more complicated affair. During Captain HANSEN's stay in the Strait of Messina in Febr.—March 1911 not only small individuals of 4—5 mm diam. but also several of 6—7 mm diam. were found, and during the summer expedition 1910 all sizes from 2—8 mm were met with at any time from June till the end of August. Thus breeding is not limited to one certain season, at any rate. The statements of the literature besides are in contradistinction to the experiences made by the "Thor", and to one another: Off the coast of Dalmatia NEPPI (1912) found mostly young specimens in June—Aug., whilst GRAEFFE (1884) found young specimens at Trieste in Oct.—Nov. which became mature in the winter months; according to LOBIANCO (1903) the species occurs at Capri in February and March. — I cannot but get to the conclusion that the breeding must take place almost all the year round, perhaps more briskly at one time than at another, varying in the different parts of the Mediterranean; but then I am quite without comprehension of the fact that the medusa was not taken at all during the winter expedition of the "Thor".

25. GERYONIA PROBOSCIDALIS (Forskål).

(Figs. 28—29 and Chart VIII).

Syn. *Carmarina hastata* Haeckel.

Material.

Stat. 28. Lat. 40°53′ N., Long. 13°43′ E. 19. I. 1909.
Y. 200 m wire, 1 specimen, diam. ca. 30 mm (alcohol).
Stat. 129. Lat. 40°05′ N., Long. 11°31′ E. 12. VII. 1910.
Y. 25 m wire, 3 specimens, 3, 5, 55 mm.
Stat. 193. Lat. 38°15′ N., Long. 15°39′ E. 21. VIII. 1910.
Y. 10 m wire, 2 specimens, small.
Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 25 m wire, 4 specimens, 5, 6, 14, 18 mm.
Stat. 196. Lat. 39°59′ N., Long. 14°31′ E. 22. VIII. 1910.
Y. 25 m wire, 1 specimen, 7 mm.
Stat. 200. Lat. 39°18′ N., Long. 10°11′ E. 26. VIII. 1910.
Y. 25 m wire, 7 specimens, 5, 6, 7, 8, 8, 10, 15 mm.
Stat. 205. Lat. 39°16′ N., Long. 5°52′ E. 27. VIII. 1910.
Y. 25 m wire, 1 specimen, ca. 35 mm.
Stat. 280. 1 mile E.S.E. of Messina lighthouse, 25. II. 1911.
Ringtrawl 15 m wire, 1 specimen, 3 mm.
Stat. 339. Lat. 40°30′ N., Long. 3°10′ E. 20. VIII. 1911.
Ringtrawl, 28 m wire, 1 specimen, 12 mm.
Stat. 341. Lat. 34°00′ N., Long. 26°20′ E. 27. VIII. 1911.
Ringtrawl, 28 m wire, 1 specimen, 5 mm.

The port of Messina. 1.—8. V. 1893. Dr. H. J. HANSEN.
8 specimens, diam. 13—34 mm (in alcohol):

no gonads	3	centripetal	canals	pr.	sextant:	diam. 13, 13, 14 mm.
	7	—	—	-	—	— 20 mm.
gonads just indicated	7	—	—	-	—	— 29, 29, 32, 34 mm.

Whilst HAECKEL (1879) divides the six-rayed *Geryonidæ* into 4 genera with 8 species, recent authors are agreed in referring them all to 1 genus with 1 species, *Geryonia proboscidalis* (Forskål) Eschscholtz. VANHÖFFEN (1902 b, p. 85) and BIGELOW (1909, p. 116) however make a reservation as regards "*Carmaris umbella*" Haeckel (from Peru), and "*Carmaris giltschii*" Haeckel (from Australia) which are possibly separate species, according to their respectively 9 and 11 centripetal canals per sextant. These numbers are, however, as will be seen, also to be met with in *Geryonia proboscidalis* from the Mediterranean, and I therefore do not see any reason to doubt that also the above mentioned Haeckelian forms belong to the species *G. proboscidalis*.

The centripetal canals are developed in 4 series, according to fixed rules. The 3 first series together form 7 canals (1 + 2 + 4); the 4 canals of series III all developing contemporaneously; in series IV, on the other hand, the development is irregularly carried out, there being a chance of 8 canals developing in this series, but I never saw more than 4, that is 11 canals in all of all 4 series in a sextant. In the large individual of 55 mm diam. (from stat. 129), a ♂ with fully developed gonads touching eachother, there are 7 canals in some sextants, 11 in others. As the individual is badly preserved, I prefer, in order to illustrate the developing method, to introduce two figures which I have drawn after a large well preserved specimen from Naples in the British Museum in London (figs. 29 a—b). Both figures are from the

same individual and represent the part of the two sextants which are outlined by the gonads. The canals are numbered according to the series to which they belong. In the first figure (29 a) the development of the canals of series IV has been symmetrically carried out, in the other figure (29 b) asymmetrically. The above mentioned individual of the "Thor" displays corresponding irregularities in the development of series IV. I see herein a proof of the canals of series IV developing where there happens to be room enough for them, which includes the possibility that all 8 may originate, in which case we would get in all 15 centripetal canals in one sextant. — According to HAECKEL's description "*Carmaris umbella*" (with 9 centripetal canals in each sextant) is 30 mm in diam., "*Carmaris giltschii*" (with 11 canals) 90—110 mm. On seeing that an individual of *Geryonia proboscidalis* of 55 mm has 7 canals in some, 11 canals in other sextants, we may take it for granted that there is a considerable individual variation in this particular, so that the number of canals, even in proportion to the size of the individual, is of no great systematic importance.

Fig. 28. *Geryonia proboscidalis* (Forskål). — From Mayer 1910.

Concerning the development of the canals and the size of the medusa at the different stages I shall give the following statement, based on investigations of the material from the Mediterranean:

In the smallest individual (diam. 3 mm, stat. 280) there is no indication of centripetal canals; the first one of these canals has just originated (interradially) in an individual of a little more than 3 mm from stat. 129. I have seen 4 individuals of 5 mm diam., in 2 of which only the interradial canal had as yet appeared, in the 2 others the two canals of series II had originated in some of the sextants. At 6 mm diam. series II are quite short, at 7 mm they are half as long as the first canal, at 8 mm somewhat more. In an individual of 10 mm diam. there are 3 canals in one sextant, 7 in the others, series III being present as 4 very short indications, all alike. — In the material from Messina, collected by Dr. H. J. HANSEN, there are 3 individuals of 13—14 mm (in alcohol) with as yet only 3 centripetal canals per sextant; in the material of the "Thor" all individuals of more than 10 mm diam. (in formalin) have 7 canals per sextant, (except for the large one which has up to 11). I never saw an individual with 5 canals per sextant; all 4 canals of series III originate and develop contemporaneously and are all alike, at any rate till they have reached a length of about half that of series II (at a diam. of ca. 18 mm), the canals of series III then may be somewhat varying in length, but the differences appear irregularly (room conditions), not on account of certain particular canals developing more quickly than other canals. Further all examined individuals of up to 34 mm diam. invariably have 7 canals per sextant. The specimen from stat. 205, diam. 35—40 mm, is so badly preserved that I cannot determine its number of canals. The largest specimen, 55 mm, has been mentioned above.

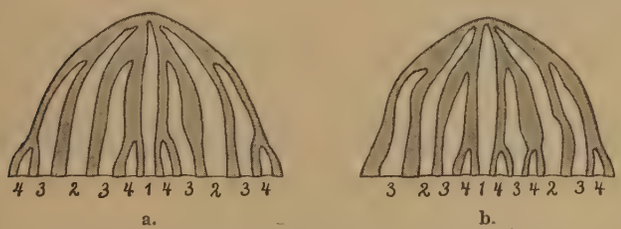


Fig. 29 a—b. *Geryonia proboscidalis.* — Diagrams showing the serial development of the centripetal canals. For further explanation, see the text, p. 35.

In the two small individuals of 3 mm the perradial larval tentacles still are present together with the permanent tentacles; in the smaller one the latter are as yet only slightly developed. The individuals of 5 mm all have thrown off the perradial larval tentacles.

The gonads do not begin developing until the medusa has attained the size of ca. 30 mm diam.

The largest but one individual of the "Thor" (35—40 mm) has rather broad gonads not touching each-other; the largest specimen, 55 mm, is a ♂ with fully developed gonads touching in the interradials.

Geographical Distribution.

Geryonia proboscidalis is an oceanic medusa occurring in all warm oceans. As emphasized by several authors, it is, however, scarce everywhere except in the Mediterranean where it is rather common, and in certain places may be found in great numbers.— It is in all places a surface form.

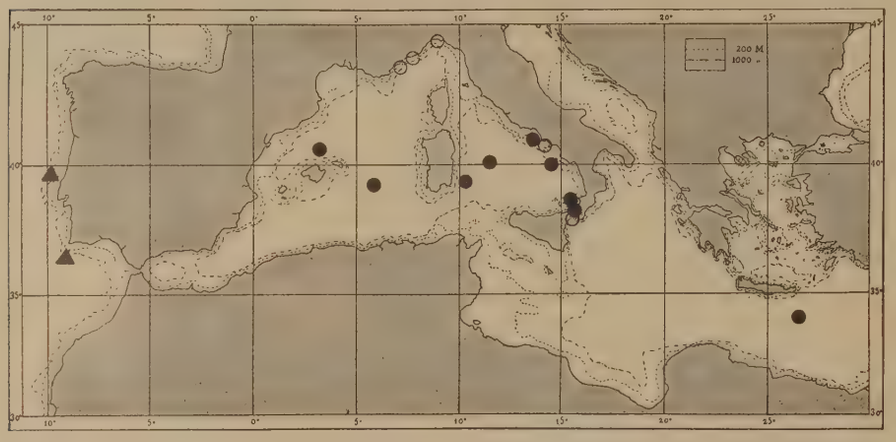


Chart VIII. ● Finds of *Geryonia proboscidalis* (Forsk.), O occurrence in the Mediterranean according to the literature.
▲ Finds of *Æginura grimaldii* Maas.

Occurrence in the Mediterranean: Nice, Mentone, Genoa, Naples, Messina, the Ægean Sea at the coast of Asia Minor, (Carus 1884, p. 38—39, *G. proboscidalis, Carmarina hastata, C. fungiformis*). — Villefranche and Messina (Metschnikoff 1886, p. 11, *G. proboscidalis*). — Naples, common in winter and spring, mature genital products Sept.—Jan. and March—April, young individuals in the plankton Oct.—April (Lobianco 1899, p. 458, *Carmarina hastata*). — Trieste, autumn and winter, scarce (Graeffe 1884, p. 28, *G. proboscidalis* and *C. hastata*).

Geryonia proboscidalis occurs all over the Mediterranean (see Chart VIII); in larger numbers it has only been met with at Naples and Messina; in the Adriatic Sea it is rare. — At the collections in the Mediterranean of the "Thor", the "Pangan", and Captain Hansen 22 individuals were found in all, mainly young. Except for an individual from stat. 341 in the Levant they are all from the western basin. In the Alboran Sea and at the coast of Algeria none were found. The sizes of the individuals found may be divided according to the seasons as represented in table III (specimens from Messina collected by Dr. H. J. Hansen 1893 included).

Table III. *Geryonia proboscidalis*. Size of individuals at different seasons.

Month	Diameter of specimens, mm.						
	3—5	5—10	10—15	15—20	20—30	30—40	55
January.....	..	..	..	..	1	..	..
February.....	1	..	..	..	..	..	..
May	..	..	3	1	2	2	..
July	2	..	..	..	..	..	1
August.....	3	7	3	1	..	1	..

As will be seen from the table, quite young as well as middle-sized individuals may be met with in the Mediterrannean, both in winter and summer. The only, large, mature individual was found in July in the middle of the Tyrrhenian Sea (stat. 129). Thus the species, at any rate, does not occur with the regularity stated by Lobianco from Naples.

NARCOMEDUSÆ.

26. ÆGINA RHODINA Haeckel.

(Fig. 30).

Material.

St. 181 (06). Lat. 49°22′ N., Long. 12°52′ W., S.W. of Ireland, 4. IX. 1906, depth 1350 m.
Y. 1800 m wire, 1 specimen, diam. 18 mm.

This species occurs in the tropical Atlantic, but in the eastern Atlantic its distribution reaches along the continental slope to ca. 58° N., between Scotland and the Rockall Bank. In these high degrees of latitude it only occurs in the deeper layers.

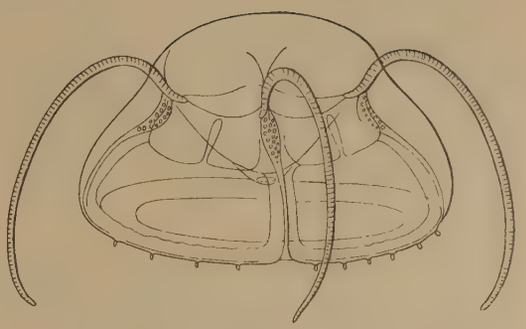


Fig. 30. *Ægina rhodina* Haeckel. — From Mayer 1910, plate 54, fig. 11.

Fig. 31. *Æginura grimaldii* Maas.— After Maas 1904 a (from Mayer 1910).

27. ÆGINURA GRIMALDII Maas.

(Fig. 31 and Chart VIII).

Material.

Stat. 71. Lat. 39°35′ N., Long. 9°45′ W. 4. III. 1909.
Y. 1600 m wire, 1 specimen.
Stat. 232. Lat. 36°28′ N., Long. 9°06′ W. 9. IX. 1910.
Y. 2000 m wire, 1 specimen, diam. 8 mm.

This medusa has a world-wide distribution in the deep-sea of all oceans. It is unknown in the Mediterranean. The "Thor" has found two specimens in deep water off the west coast of Portugal and in the Bay of Cadiz.

28. CUNINA RUBIGINOSA (Kölliker).

(Fig. 32 and Chart IX).

Eurystoma rubiginosum Kölliker 1853, p. 322.
Aegineta gemmifera Keferstein & Ehlers 1861.
Cunina rhododactyla + *C. rubiginosa* Haeckel 1864 and 1879.
Cunina rhododactyla Metschnikoff 1886, p. 251.
Cunina prolifera Mayer 1910, p. 480.
non *Cunina prolifera* Gegenbaur 1854.

Metschnikoff (1886) correctly identifies *Cunina rhododactyla* Haeckel with *Eurystoma rubiginosum* Kölliker, but he uses Haeckel's specific name, and so does also Maas (1904 a, p. 32) as the species has been well described and figured by Haeckel. Kölliker does not give any figure of his medusa, but his description does not seem to me to allow any doubt of the identity. If the name proposed by Kölliker were to be dropped, there would, at any rate, not be any reason for proceeding as far as to Haeckel as there can hardly be any doubt that *Aegineta gemmifera* Keferstein & Ehlers 1861 also does belong to this species. — It is most unfortunate that Mayer in his monograph (1910) introduces the name *Cunina prolifera* Gegenbaur for the species in question. It is unfortunate, not only because Kölliker's name

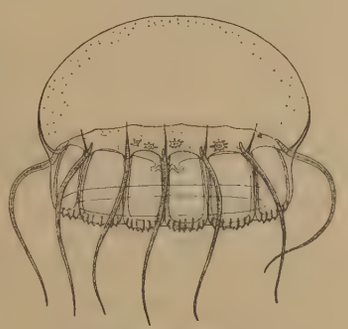


Fig. 32. *Cunina rubiginosa* (Köl liker). — From Mayer 1910.

is of older date, but also because it is more than dubious that *C. prolifera* be identic with *rubiginosa* and *rhododactyla*; it is much more likely that it belongs to the same species as *C. proboscidea* Metschnikoff. *C. prolifera* Gegenbaur must be referred to the dubious species, and the same will apply to *Aegineta rosea* Gegenbaur (1856, p. 261, Taf. X, fig. 6, 7) which Mayer without reservation accepts in his list of synonyms. — Bigelow who has undertaken a revision of part of the much disputed species of the genus *Cunina* (Bigelow 1909, p. 55 ff.) places *C. prolifera* among the dubious species, and applies the name of *C. rubiginosa* to the present species, in which I fully agree with him.

Material.

Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 25 m wire, 2 specimens, diam. 4—6 mm.
Stat. 196. Lat. 39°59′ N., Long. 14°31′ E. 22. VIII. 1910.
Y. 25 m wire, 26 specimens, 5—7 mm.
Stat. 199. 39°32′ N., Long. 10°49′ E. 25. VIII. 1910.
Y. 25 m wire, 1 specimen, 6 mm.
Y. 300 m wire, 2 specimens, 6 mm.
Stat. 200. Lat. 39°18′ N., Long. 10°11′ E. 26. VIII. 1910.
Y. 25 m wire, 23 specimens, 2—7 mm.
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Y. 2000 m wire, 1 specimen, 7 mm.

The Strait of Messina, Captain Hansen:

Stat. 282. 8. III. 1911.
Ringtrawl, 40 m wire, 3 specimens, 5—6 mm.
Stat. 283 a. 12. III. 1911.
Ringtrawl, 40 m wire, 3 specimens, 7—8 mm.
Stat. 283 b. 13. III. 1911.
Ringtrawl, 40 m wire, 3 specimens, 5—6 mm.

"Pangan" 1911:

Stat. 297. Lat. 33°10′ N., Long. 25°03′ E. 25. VI. 1911.
Ringtrawl, 28 m wire, 1 specimen, 7 mm.

Brood, which in this medusa are kept in the stomach cavity of the mother animal, is only present in a few of the examined specimens (from stat. 196 and 200), that is in those which are well preserved, in particular having a whole stomach, in contradistinction to the rest of the specimens. The want of brood in the others presumably is due to the bad preservation, the stomach wall being rent or completely torn off so that the brood eventually contained in the stomach has been lost.

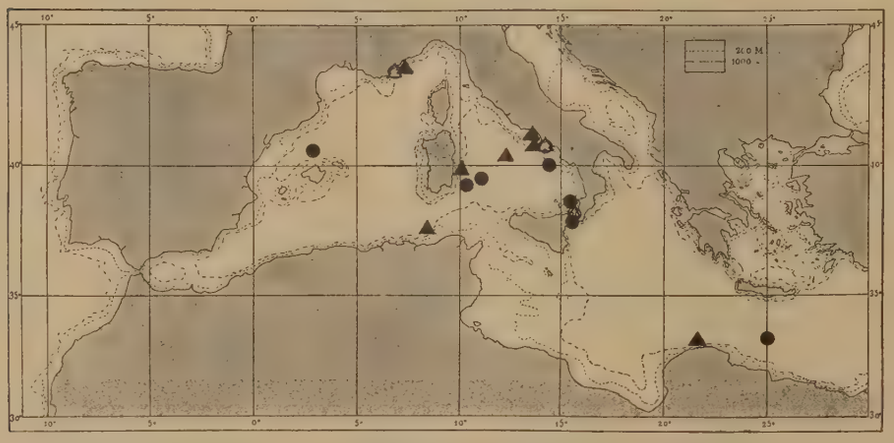


Chart IX. ● Finds of *Cunina rubiginosa* (Köll.), ○ occurrence according to the literature.
▲ Finds of *Solmissus albescens* (Ggb.), △ occurrence according to the literature.

Further distribution in the Mediterranean: Villefranche, Nice (Haeckel); Naples (Keferstein & Ehlers, Carus); do., larvæ on "*Carmarina hastata*" in Nov.—July, especially in February (Lobianco 1888). — Capri, Febr.—March (Lobianco 1903—04). — Messina (Kölliker, Metschnikoff). — According to Mayer (1910) the medusa is "quite common in the Mediterranean during the winter, but more abundant in spring".

Maas (1904 a) records this medusa from 3 localities in the Atlantic: 48° 22′ N. 17° 43′ W.; 30° 47′ N. 24° 53′ W.; 30° 45′ N. 25° 21′ W., all in July and August. These statements provisionally are the only ones I know from the Atlantic.

The distribution of *C. rubiginosa* in the Mediterranean, as far as we know it from the literature and from the "Thor", in every particular agrees with the distribution of *Geryonia proboscidalis*, excepting

that the latter has been found at Trieste, whilst *C. rubiginosa* never was taken in the Adriatic. This community in occurrence is most natural, the larva of *Cunina rubiginosa* living in *Geryonia*.

C. rubiginosa, like *Geryonia*, is a pronounced surface form; only once it was found in a deep haul at stat. 209, north of the Baleares, where 1 specimen was collected in a haul with 2000 m wire out; this seems very strange, but it may be that the specimen was not really taken in that depth.

The seasons at which the material of the "Thor" was collected are far from agreeing with MAYER's statement of the medusa as occurring in winter and the most abundantly in spring. It was, on the whole, not found during the winter expedition of the "Thor", whilst it was taken, partly even rather abundantly, in the month of August (1910) far out in the Tyrrhenian and the Balearic Seas; the only specimen from the eastern basin ("Pangan" stat. 297) was taken in June. At the collections of Captain HANSEN in the Strait of Messina the medusa was, however, taken in March. The medusa thus occurs in the Mediterranean all the year round, still it is possible that only in winter and spring it approaches the coasts where all former collections were made.

29. SOLMISSUS ALBESCENS (Gegenbaur).

(Fig. 33 and Chart IX).

Material.

Stat. 24. Lat. 40°14′ N., Long. 12°23′ E. 16. I. 1909.
Y. 300 m wire, 5 specimens, diam. 16—18 mm.
Stat. 26. Lat. 40°40′ N., Long. 13°59′ E. 19. I. 1909.
Y. 65 m wire, 3 specimens, ca. 17 mm.
Stat. 28. Lat. 40°53′ N., Long. 13°43′ E. 19. I. 1909.
Y. 200 m wire, 4 specimens, 17, 17, 20, 30 mm.
Stat. 35. Lat. 43°36′ N., Long. 7°36′ E. 29. I. 1909.
Y. 200 m wire, ca. 22 specimens, ca. 17—26 mm.
Stat. 39. Lat. 39°41′ N., Long. 10°02′ E. 1. II. 1909.
Y. 1000 m wire, ca. 85 specimens, ca. 14—23 mm.
Stat. 45. Lat. 37°28′ N., Long. 8°18′ E. 7. II. 1909.
Y. 65 m wire, ca. 170 specimens, ca. 15—31 mm, the majority 22—25 mm.
Y. 300 m wire, ca. 85 spec., ca. 15—26 mm, mostly large.
Stat. 152. Lat. 33°11′ N., Long. 21°44′ E. 27. VII. 1910.
Y. 300 m wire, ca. 5 specimens, ca. 17 mm.

Further distribution: only known from the Mediterranean: Nice, Naples, Messina (CARUS 1884, p. 42). — According to MAYER (1910, p. 482) this species is quite common in the Mediterranean.

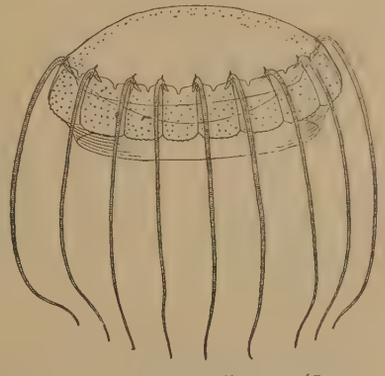


Fig. 33. *Solmissus albescens* (Gegenbaur). — From Mayer 1910.

As will be seen from the above list, the "Thor" found this medusa in great numbers during the winter expedition in the Tyrrhenian and Balearic Seas in January and February 1909, whilst during the summer expedition 1910 it was only met with in a few specimens at a station near the Cyrenaïca peninsula towards the end of July. These specimens were just as large as many of the specimens found in winter. The medusa therefore must be supposed to occur in the Mediterranean all the year, its maximum still belonging to the winter, unless the stock mainly keeps to the deepest strata and only in winter rises to the upper strata. The material from the winter expedition of the "Thor" was collected in very different depths, 65—1000 m wire out, and the number of individuals does not seem to be in any evident proportion to the depths. Attention is called to the fact that almost all the localities are rather close by land; this does f. inst. come true as to the stations 39 and 45, where the medusa was found in especially great numbers. It ought to be stated that all the fished specimens are in a very poor condition, without stomach and gonads and at best with faint rests of muscles; they do in reality only consist of the umbrellular mesogloea and the tentacles which seem to be very resistent. It seems as if all the individuals were dead before being hauled up. Probably the medusa is a pronounced deep-sea form, living near by the bottom in the deep basins where the living individuals have been avoided, even by the deep going implements of the "Thor". When certain currents drive the

bottom water upwards and towards the coasts, the medusa may follow and occasionally appear abundantly in the vicinity of the land. The great number of the medusa, found by the "Thor", partly as far upwards as at ca. 40 m below the surface, certainly are individuals, having been carried from the depth upwards to water layers to which they do not belong, and in which they cannot live, not individuals which have died from senility after breeding. The fact is that a considerable part of these medusæ have reached only half the fullgrown size (which is, according to MAYER, 25—30 mm). They have surely been killed by the altered surroundings after having been carried off from their homestead, the depth (see the General Part).

SCYPHOMEDUSÆ.

30. PERIPHYLLA HYACINTHINA (Faber).

(Fig. 34 and Chart X).

Material.

Lat. 48° N., Long. 8° W. Capt. Hygom 1851. 1 specimen.
Lat. 39°N., Long. 13° W. Capt. Hygom 1863. 1 specimen.
Stat. 24. Lat. 40°14′ N., Long. 12°23′ E. 16. I. 1909.
Y. 25 m wire, 2 specimens, diam.[1]) 13—19 mm.
- 1600 - — 1 — — 35 -
Stat. 29. Lat. 40°47′ N., Long. 12°55′ E. 20. I. 1909.
Y. 1650 m wire, 1 specimen, diam. 25 mm.
Stat. 45. Lat. 37°28′ N., Long. 8°18′ E. 6. II. 1909.
Y. 300 m wire, 3 specimens, diam. 10, 13, 16 mm.
Stat. 50. Lat. 37°02′ N., Long. 1°27′ E. 17. II. 1909.
Y. 1600 m wire, 3 specimens, diam. 11, 18, 35 mm.
Stat. 51. Lat. 36°27′ N., Long. 0°37′ W. 18. II. 1909.
Y. 300 m wire, 19 specimens, diam. 8—20 mm.
Stat. 53. Lat. 36°13′ N., Long. 1°28′ W. 18. II. 1909.
Ringtrawl, 2600 m wire, 7 specimens, diam.13—29 mm.
Stat. 69. Lat. 36°13′ N., Long. 9°44′ W. 28. II. 1909.
Ringtrawl, 3000 m wire, 1 specimen, diam. 30 mm.
Stat. 76. Lat. 47°01′ N., Long. 5°48′ W. 10. III. 1909.
Y. 1600 m wire, 2 specimens, diam. 13—16 mm.
Stat. 89. Lat. 36°28′ N., Long. 8°22′ W. 18. VI. 1910.
Y. 1000 m wire, 1 specimen, diam. 8 mm.
Stat. 106. Lat. 36°33′ N., Long. 2°00′ W. 25. VI. 1910.
Y. 1200 m wire, 36 specimens, diam. 5—20 mm.
Stat. 107. Lat. 36°13′ N., Long. 1°28′ W. 25. VI. 1910.
Y. 2000 m wire, 18 specimens, diam. 10—25 mm.
Stat. 108. Lat. 36°03′ N., Long. 0°27′ W. 26. VI. 1910.
Y. 2000 m wire, 21 specimens, diam. 10—30 mm.
Stat. 115. Lat. 38°17′ N., Long. 4°11′ E. 29. VI. 1910.
Y. 2000 m wire, 11 specimens, diam. 8—35 mm.
Stat. 122. Lat. 43°50′ N., Long. 8°34′ E. 2. VII. 1910.
Y. 1200 m wire, 7 specimens, diam. less than 10 mm.
Stat. 206. Lat. 39°32′ N., Long. 5°15′ E. 28. VIII. 1910.
Y. 1000 m wire, 3 specimens, diam. ca. 10 mm.
- 2000 - — 9 — — 10—24 -
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Y. (depth unknown), 10 specimens, diam. 7—20 mm.
Stat. 231. Lat. 35°56′ N., Long. 7°16′ W. 9. IX. 1910.
Y. 300 m wire, 2 specimens, diam. 12—20 mm.
Stat. 232. Lat. 36°28′ N., Long. 9°06′ W. 9. IX. 1910.
Y. 300 m wire, 1 specimen, diam. 18 mm.

Geographical Distribution.

The Mediterranean: LOBIANCO (1903—04, p. 219) records "*Periphylla dodecabostrycha*" from the Gulf of Naples, but, according to MAYER (1910, p. 546) the identification is not correct. *Periphylla* was not known from the Mediterranean until 1904 (MAAS 1904 a, p. 47, Pl. V, figs. 36—37, *Periphylla dodecabostrycha*; p. 47, Pl. V, fig. 35 and Pl. VI, figs. 45—46, *P. hyacinthina*). MAAS records the species from deep water in three localities between Monaco and Corsica. — The "Michael Sars" North Atlantic deep-sea expedition 1910 found 8 specimens at stat. 19 in the Mediterranean, just inside the Strait of Gibraltar, May 2nd 1910 (BROCH 1911, p. 4, *P. hyacinthina*). As far as I am aware these are the only finds of *Periphylla hyacinthina* in the Mediterranean hitherto known.

Outside the Mediterranean: *Periphylla hyacinthina* (with *dodecabostrycha*) is widely distributed in the deep-sea of all the oceans, including the Norwegian Sea. In the colder parts of the North Atlantic it is occasionally found at the surface (see below).

The "Thor" did not find this species in the eastern basin of the Mediterranean. On the other hand, it proved to be generally distributed in all parts of the western basin. Moreover, it was found at

[1] The diameter is measured between the roots of opposite tentacles, the marginal lappets not included.

four stations in the Cadiz Bay, and at stat. 76 in the Bay of Biscay. At the latter station two small specimens were taken in a haul with 1600 m wire out. In the Cadiz Bay a number of small and medium-sized individuals were found in intermediate water layers (300—1000 m wire out). A single specimen, 30 mm wide, was taken in very deep water (stat. 69, 3000 m wire).

Seasonal and bathymetrical occurrence in the Mediterranean. — *Periphylla hyacinthina* occurs in the Mediterranean all through the year. If we divide the specimens from the "Thor" into three groups, according to the size: small (diam. 5—15 mm), medium-sized (15—25 mm), and large (25—35 mm), we shall find that the percentage number of each group is nearly the same in winter and summer (table IV). Thus, as in other deep-sea medusæ, there is no definite time of breeding. As regards the vertical distribution we will find that the medusa was found in every depth from the surface down to the greatest depths in which hauls were made. But it is not uniformly distributed in the different strata. The average number of individuals per one haul of 1 hour's duration are as follows: 25 m wire: 4; 300 m wire: 22; 1000—1200 m wire: 18; 1600—2600 m wire: 9. Thus, the greatest number of specimens are found in the intermediate water layers, between 150 and 600 m below the surface. An analysis of the size of the individuals (table V) will show, however, that no fullgrown specimens are found in less than about 800 m' depth (1600 m wire). From that depth towards the bottom one or more specimens, more than 25 mm wide, are found in almost every haul. Young specimens are met with at every depth right through from the surface to the deep-water strata, but they are the most abundant in the strata between 150 and 600 m. It is interesting to compare these results with what I have found to be the case in the Greenland waters. In my paper on the medusæ from the "Tjalfe" expeditions to the

Table IV. Percentage of small, middle-sized, and large individuals of *Periphylla hyacinthina* in the Mediterranean (Stat. 209 included).

Season	Diam. of specimens, mm.		
	5—15	15—25	25—35
Winter (Jan.—Febr.)	50	39	11
Summer (June—August)	56	35	9

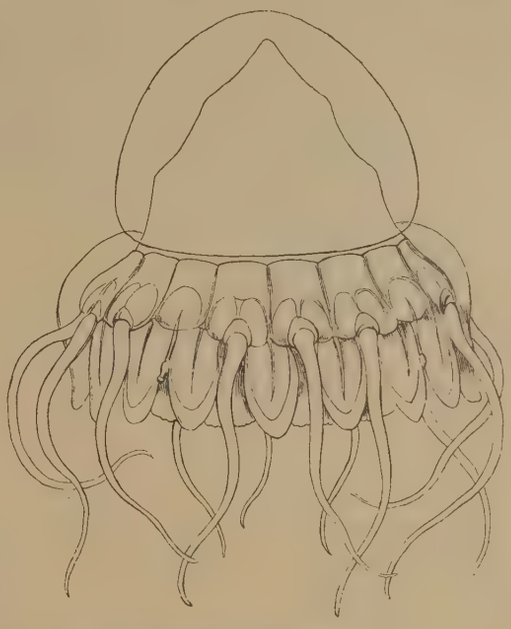


Fig. 34. *Periphylla hyacinthina* (Faber). — From Vanhöffen 1906, Nord. Plankton.

Chart X. ● Finds of *Periphylla hyacinthina* (Faber), ○ occurrence in the Mediterranean according to the literature.

west coast of Greenland (KRAMP 1913, p. 279) I have worked out a table similar to table V in the present paper. I found that specimens of every size may be found at every depth, but small individuals are more abundant in the deeper strata. It appears that in the Davis Strait the real home of *Periphylla* is the deeper water, but large specimens may occasionally ascend towards the surface. In the Mediterranean the young individuals seem normally to ascend into the intermediate, occasionally even into the upper strata, but sink to the deep water once more before breeding. The species seems to grow to a much larger size in the Arctic than in the Mediterranean. South-east of Greenland specimens up to 50 cm wide have been measured, whereas the largest specimen hitherto found in the Mediterranean was only 4 cm wide.

Table V. Vertical distribution of *Periphylla hyacinthina* in the Mediterranean. Number of small, middle-sized, and large individuals per one hour's haul with young-fish trawl.

Stat. no.	m wire out	Approximate depths	Diameters of the individuals		
			5—15 mm	15—25 mm	25—35 mm
		meters			
24	25	0	2	2	0
45	300	150	4	2	0
51	—	—	22	16	0
206	1000	500	4	0	0
106	1200	600	31	5	0
122	—	—	14	0	0
24	1600	800	0	0	1
50	—	—	1	1	1
29	1650	900	0	1	0
107	2000	1000	3	12	3
108	—	—	3	12	6
115	—	—	3	6	2
206	—	—	8	4	0
53	2600	1400	3	2	2

31. NAUSITHOË PUNCTATA Kölliker.

(Fig. 35 and Chart XI).

Material.

Stat. 45. Lat. 37°28′ N., Long. 8°18′ E. 7. II. 1909.
1 mature specimen, diam. 8 mm.
Stat. 69. Lat. 36°13′ N., Long. 9°48′ W. 28. II. 1909.
Y. 65 m wire, 5 specimens, diam. 9—10 mm.
- 600 - — 3 — — 7, 8, 12 mm.
Stat. 136. Lat. 37°01′ N., Long. 10°31′ E. 19. VII. 1910.
Y. 25 m wire, 1 specimen, diam. 5. mm.
Stat. 145. Lat. 32°38′ N., Long. 19°02′ E. 25. VII. 1910.
Y. 25 m wire, 3 specimens, diam. 4 mm.
Stat. 183. Lat. 37°52′ N., Long. 23°09′ E. 16. VIII. 1910.
Y. 65 m wire, 1 specimen, diam. 10 mm, mature.
Stat. 184. Lat. 38°10′ N., Long. 22°33′ E. 17. VIII. 1910.
Y. 10 m wire, 9 specimens, diam. 5—6 mm.
Stat. 194. Lat. 38°33′ N., Long. 15°29′ E. 21. VIII. 1910.
Y. 25 m wire, 3 specimens, diam. 4 mm (contracted).
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
Y. 25 m wire, 2 specimens, diam. 8—10 mm.
Stat. 210. Lat. 41°10′ N., Long. 2°23′ E. 30. VIII. 1910.
Y. 25 m wire, 33 specimens, diam. 5—8 mm.

Messina Strait, Capt. HANSEN, 1 m ringtrawl, 40 m wire:
Stat. 282. 8. III. 1911.
2 specimens, diam. 6—8 mm.
Stat. 283 a. 12. III. 1911.
4 specimens, diam. 7—11 mm.
Stat. 283 b, 13. III. 1911.
1 specimen, diam. 7 mm.

Stat. 276. ("Pangan"). Lat. 36°30′ N., Long. 19°20′ E. 4. IV. 1911.
2 m ringtrawl, 132 m wire, 7 specimens, diam. 7—10 mm.
Stat. 297. ("Pangan"). Lat. 33°10′ N., Long. 25°20′ E. 25. VI. 1911.
2 m ringtrawl, 28 m wire, 1 specimen, diam. 12 mm.

Further Distribution.

The Mediterranean: Gulf of Naples, strobila and ephyra in June, adult medusa common at the surface during the winter and spring, Nov.—March (LOBIANCO 1899, p. 463). — Messina (CARUS 1884, p. 51). — Trieste, ephyra in May and June, adult specimens June—October, somewhat rare, mature eggs August—September (GRAEFFE 1884, p. 342); medusæ found July—September (STEUER 1902 and 1903).

Outside the Mediterranean: *Nausithoë punctata* is a surface-water species, widely distributed in all oceans, including the Arctic; it is, however, most common in the warmer regions.

The investigations of the "Thor" have demonstrated that *Nausithoë punctata* occurs in all parts

of the Mediterranean. As the strobila is littoral (commensal within certain sponges), we might expect the medusa to be most common in the neighbourhood of the coasts, and, as a matter of fact, most places, in which the species was found by the "Thor", are not far from land. The life-period of the medusa is, however, sufficiently long as to allow it to be carried far out at sea, as demonstrated by the find of a number of specimens at stat. 276, in the middle of the Ionian Sea.

The medusa was almost exclusively found in the uppermost water layers. Only at stat. 69, in the Cadiz Bay, some specimens were found in a haul with 600 m wire out. Only at one occasion it was found abundantly, *viz.* at stat. 210, in the Catalonian Sea. It seems peculiar that the species was never found in the Alboran Sea, though collections were made here at very different seasons (February, June, and September). On the whole, only a comparatively small number of neritic medusæ were found by the "Thor", but, as a matter of fact, most of them were just found in the Alboran Sea.

Fig. 35. *Nausithoë punctata* Kölliker. — From Vanhöffen, Nord. Plankton.

As to the seasonal occurrence, there is a remarkable difference between the statements of the two distinguished authors, Lobianco and Graeffe. They both agree as far as the first appearance of the medusa is concerned: in the Gulf of Trieste as well as in the Gulf of Naples the ephyræ are found in May or June. But in the Gulf of Trieste (according to Graeffe 1884, confirmed by Steuer 1902 and 1903) adult medusæ occur during the summer and disappear in September or October, whereas in the Gulf of Naples the medusa is common all through the winter, not attaining maturity until November, and present still in the month of March.

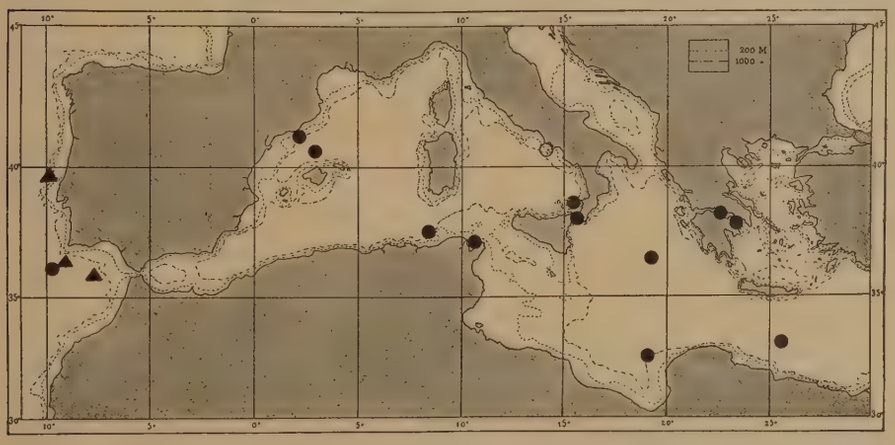


Chart XI. ● Finds of *Nausithoë punctata* Köll., ○ occurrence in the Mediterranean according to the literature.
▲ Finds of *Atolla bairdii* Fewkes.

The present material contains young specimens (diam. 4—5 mm) from July and August (1910); from August we also possess a number of middle-sized individuals (up to 10 mm in diameter). Mature specimens were found in the Tyrrhenian Sea (stat. 45) and in the Cadiz Bay in February (1909) and in the Strait of Messina in March (1911). In both cases also fairly small specimens occurred (diam. 6—7 mm), which indicates that the strobilisation is not limited to a short period (May and June, *cfr.* Graeffe and Lobianco). The species was not found in the eastern basin during the winter cruise; this may be a casuality, as middle-sized and large specimens (diam. 7—12 mm) were taken by the "Pangan" in the Ionian Sea and the Levant in April and June (1911). — Thus we may state that young specimens of *Nausithoë punctata* appear in the summer; towards the end of the summer young specimens are still present together with middle-sized individuals; middle-sized and full-grown specimens occur during the winter and spring.

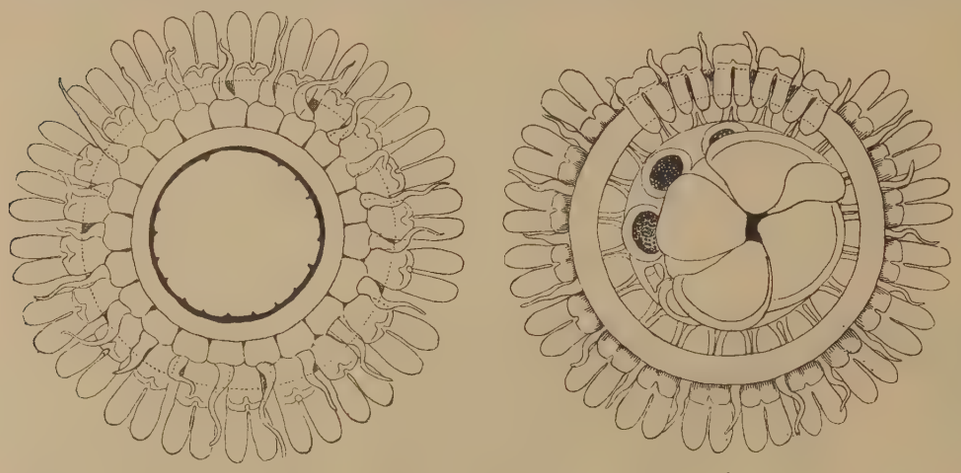
32. ATOLLA BAIRDII Fewkes.

(Fig. 36 and Chart XI).

Material.

Stat. 69. Lat. 36°13′ N., Long. 9°44′ W. 28. II. 1909.
Y. 600 m wire, 1 specimen, diam. 17 mm.
2 m ringtrawl, 3000 m wire, 4 specimens, diam. 15—21 mm.
Stat. 71. Lat. 39°35′ N., Long. 9°45′ W. 4. III. 1909.
Y. 600 m wire, 5 specimens, diam. 8—16 mm.
- 1600 - — 3 — — 12, 15, 33 mm.
Stat. 75. Lat. 45°37′ N., Long. 7°03′ W. 9. III. 1909.
2 m ringtrawl, 4300 m wire, 4 specimens, diam. 16, 70, 74, 83 mm.
Stat. 91. Lat. 35°53′ N., Long. 7°26′ W. 18. VI. 1910.
Y. 1600 m wire, 8 specimens, diam. 6—13 mm.
Stat. 232. Lat. 36°28′ N., Long. 9°06′ W. 9. IX. 1910.
Y. 2000 m wire, 6 specimens, diam. 8—20 mm.

Broch (1911) has thoroughly dealt with the problem of the identity of *Atolla bairdii* Fewkes and *A. verrillii* Fewkes[1]. Being in possession of a considerable material from the Atlantic, he has been able to discuss the problem from different points of view. He comes to the conclusion that they cannot be kept apart, not even as geographical or biological forms, and he states that the radial furrows of the central disk which has been assumed to separate *A. verrillii* from *A. bairdii*, are due to contraction. Having examined the 31 specimens of *Atolla*, caught by the "Thor", I fully agree with Broch.



a. b.

Fig. 36 a—b. *Atolla bairdii* Fewkes. — After Fewkes (from Nord. Plankton). — *a*, seen from the top, showing the circular grooves and indications of the radial furrows on the disk; *b*, seen from below, showing the annular muscle.

Broch found that in specimens with radial furrows the central disk was comparatively smaller (in proportion to the total diameter), *i. e.* more contracted, than in specimens with smooth surface. Now we must remember, 1° that measurements of contractile animals like medusæ never can be exact; that is to say when a sufficient number of observations are regarded collectively the most important faults will however be eliminated; 2° that the contraction is not limited to one single organ but involves also other parts of the body and that in very different ways. As a matter of fact, in Broch's material as well as in mine the relative diameter of the central disk is subject to a considerable variation, so much so, indeed, that the probable error far surpasses the difference between the two figures which represent the average relation in the two groups of specimens (smooth and furrowed). In the material from the "Thor" I have found the following average relation (expressed in %) between the diameter of the central disk and the total diameter of the medusa: in specimens with smooth surface or with only slight indications of radial furrows: 48 %; in specimens with distinct radial furrows: 44 %. This result is in accordance with Broch's statements, but, as already remarked, we cannot be sure that the results are correct. A better standard for the state of contraction is the relation between the diameters of the central disk and the annular muscle on the subumbrella (see fig. 36 b), first because they can both be measured fairly exactly, secondly because there is a natural correlation between the two organs, each of them acting antagonistically to the

[1] Mayer (1910) considers *A. verrillii* as a variety of *A. wyvillei* Haeckel. Mayer is undoubtedly wrong in this supposition.

Table VI. *Atolla bairdii.*

Total diam.	Ring-muscle diam.	Central disk			Number of tentacles	Radial furrows, and other remarks
		diam.	% of tot. diam.	% of ring-muscle		
mm	mm	mm				
6	5	?	?	?	?	?
8	6	?	?	?	21	?
8	6	?	?	?	22	?
8	6	3.5	44	58	19	?
10	7	?	?	?	20	?
10	8	?	?	?	20	?
10	8	5	50	63	20	?
11	8	?	?	?	24	?
12	10	?	?	?	24	?
12	9	?	?	?	?	?
13	10	6	46	60	20	?
13	10	6	46	60	20	very slight
14	10	6	43	60	20	very slight
14	11	7	50	64	20	absent
15	11	6	40	54	24	slightly indicated
15	12	7	46	58	20	distinct, preserved in alcohol
15	12	6	40	50	19	— — - —
16	12	7	44	58	20	— — - —
16	13	6	38	46	20	— — - —
16	13	8	50	62	20	very slight
16	11	7	44	64	20	absent
17	13	8	47	62	24	distinct, preserved in alcohol
17	12	7	41	58	20	— — - —
19	15	8	42	53	24	distinct in outer $^1/_5$ of periphery, ring-furrow deep
20	16	8	40	50	20	distinct, central disk very thick
20	16	10	50	63	20	slight
21	17	10	48	59	20	very distinct, preserved in alcohol
33	26	16	48	62	19	very distinct
70	53	33	47	62	24	distinct in peripheral part
74	53	39	53	73	22	very slight
83	60	44	53	74	22	absent

other during the swimming movement of the animal. When the powerful ring-muscle is contracted (its diameter decreased) the central disk becomes expanded, its outer surface extended, and thereby smoothened. When the ring-muscle is relaxed (its diameter widened), the central disk becomes contracted; this contraction takes place partly in a circular direction, and thus the radial furrows become distinct. In the present material the average relation between the diameter of the central disk and the outer diameter of the ring-muscle has been calculated as follows: in specimens with smooth surface or with only slight traces of radial furrows: 64 % (67 % and 62 % respectively); in specimens with distinct radial furrows: 56 %. A further evidence that the radial furrows are due to contraction of the central disk, is found in the fact that the furrows are particularly distinct in specimens preserved in alcohol. — Table VI gives all the details on which the above calculations are based. In most of the very small specimens the conditions of the central disk could not be determined. Nevertheless, they are included in the table, especially in order to demonstrate the number of tentacles which, in the present material, varies between 19 and 24, without any relation to the size of the individuals. — According to MAYER (1910, pp. 563 and 567) the usual number of tentacles in *Atolla bairdii* and *verrillii* is 22. In the present material, however, 22 is a very rare number of tentacles (see the adjacent table). In the majority of the specimens we find the numbers 20 or 24, *i. e.* the numbers divisable

Tent.	Indiv.
19	3
20	16
21	1
22	3
23	0
24	6

by 4. This indicates a distinguished symmetry in the medusa, all of the four quadrants having, as a rule, an equal number of tentacles, either 5 or 6, five in each quadrant being the number most frequently found (in 55 % of the specimens examined).

Distribution.

Atolla bairdii is a widely distributed deep-sea medusa. In certain regions it may occasionally be carried to the surface; MAYER (1910, p. 565) mentions the Gulf Stream area off the Carolina coast as an instance of such regions. In the Davis Strait it is strictly confined to the deep strata (comp. *Periphylla*). — No species of *Atolla* were ever found in the Mediterranean. The "Thor" found a number of specimens, some of which were of considerable size, in the Bay of Biscay (stat. 75) in very deep water (4300 m wire out, or more than 2000 m below the surface). Moreover, the species was found off the west coast of Portugal, and in the Cadiz Bay (see Chart XI, p. 43). Young specimens occurred in February, March, June, and September.

33. PELAGIA NOCTILUCA (Forskål).

(Fig. 37 and Chart XII).

In 1888 VANHÖFFEN attempted a revision of the different species of *Pelagia*. In the material taken home from the circumnavigation of the "Vettor Pisani" in 1882—85 VANHÖFFEN meant to be able to recognize 7 species of *Pelagia* of which 3 were new to science. As a means of separating the species, the form and size of the nettle-warts and the relation between the length of the oral tube and the oral arms were mainly used. Through later investigation of new material VANHÖFFEN was, however, lead to acknowledge that several of the *Pelagia* species cannot be kept separated. In his paper on the *Scyphomedusæ* of the "Valdivia" expedition (1902 a) he namely gathers all the *Pelagia*, collected in the tropic Atlantic and the Indian Ocean, under the name of *P. phosphora*. After having examinated the material from the German South-polar expedition (VANHÖFFEN 1908) he further gives up separating *P. phosphora* and *P. noctiluca*, keeping the name of the latter. In his papers from 1888 and 1902 VANHÖFFEN has stated a series of measurements of considerable importance. The question, how many *Pelagia*-species exist, and how they are mutually separated has not by far been answered as yet, and several measurements like those of VANHÖFFEN will have to be undertaken on material from different geographical regions before we can come to any final conclusion. MAYER (1910) is right in calling the attention to the following statement that "it seems probable that the foldings observed by VANHÖFFEN in the nettle-warts are largely due to shrinkage in alcohol". BIGELOW (1909, p. 44) makes the following remark about two specimens of *Pelagia* from the Pacific: "The nettle-warts are nearly round in the smaller specimen, more oval in the larger", and the depth of the incision in the marginal lappets "varies even in the different lappets of a single specimen". Both these observations I have also made on individuals from the Atlantic and the Mediterranean. BIGELOW states that the Pacific specimens, examined by him, fall within the limits of variation, as stated by VANHÖFFEN concerning *P. phosphora* from the tropical Atlantic and the Indian Ocean. Provisionally, BIGELOW, however, uses the name *P. panopyra* Péron given to the Pacific species which was first described, as it is not certain that more species of *Pelagia* are not existing. He means namely that there is every reason to believe that the north-atlantic *P. perla* Slabber and the Mediterranean *P. noctiluca* Forskål are good species.

Fig. 37. *Pelagia noctiluca* (Forskål).— From Nord. Plankton.

Table VII. ***Pelagia noctiluca.*** **— Correlation between bell-diameter and length of mouth-tube in specimens from the Atlantic (ordinary types) and from the Mediterranean (italics).**

Length of mouth-tube	Diameter of bell, mm															
	10		20		30		40		50		60		70		80		90
mm																
3	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	*1*	..	..	..	..	..	..	..	..	..	..	..	..
5	..	*1*	2	*1*	3	..	1	..	..	..	..	..	..	..	..	..
6	..	*3*	6	*4*	2	..	..	..	..	..	..	..	..	..	..	..
7	..	*1*	1	*3*	6	*4*	3	*1*	..	..	..	..	..	..	..	..
8	..	*3*	..	*3*	3	*6*	1	..	..	..	1	..	..	..	..	..
9	..	..	1	*1*	1	*4*	4	*1*	2	..	..	..	..	..	..	..
10	..	..	..	*2*	1	*6*	..	*1*	1	..	1	..	..	..	..	..
11	..	..	..	*1*	..	*1*	..	*2*	2	..	1	..	..	..	..	..
12	..	..	..	*1*	..	*2*	1	*4*	..	*5*	1	..	..	..	..	..
13	..	..	..	*1*	..	..	..	*1*	..	*1*	..	*1*	..	..	..	..
14	..	..	..	..	..	*3*	..	*2*	..	*3*	..	*1*	..	..	1	..
15	..	..	..	..	..	*1*	..	..	..	..	..	*2*	1	..	1	*1*
16	..	..	..	..	..	..	..	..	..	..	1	*1*	1	*1*	..	..
17	..	..	..	..	..	..	..	..	..	*2*	1	*2*	1	..	..	..
18	..	..	..	..	..	..	..	..	..	..	1	*2*	1	*3*	..	..
19	..	..	..	..	..	..	..	..	..	..	..	*1*	1	*1*	..	*1*
20	..	..	..	..	..	..	..	..	..	..	..	*2*	..	*2*	..	..
21	..	..	..	..	..	..	..	..	..	*1*	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	*1*
25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	*1*
Total	2	*8*	10	*18*	16	*27*	10	*12*	5	*12*	8	*12*	5	*7*	3	*4*
Average	3.0	*6.8*	6.2	*7.9*	7.0	*9.8*	8.2	*11.4*	10.0	*14.2*	14.5	*16.8*	17.0	*18.4*	18.0	*20.7*
Average length of mouth-arms	7.0	*13.1*	17.1	*21.5*	21.0	*30.3*	32.9	*42.6*	43.6	*47.7*	55.5	*56.5*	68.2	*67.7*	67.3	*75.5*

In order to contribute to the solution of these problems I have undertaken a series of measurements and investigations of the large material of *Pelagia* of the "Thor" from the Mediterranean and the northern Atlantic. I hope to be able to return to these questions when dealing with material from the warmer parts of the Atlantic, and I then intend to take up for a more thorough discussion the measurements which have been accomplished by Vanhöffen (1888 and 1902 a) and by Broch (1911) who have measured a great number of *Pelagia* from the Atlantic.

According to former statements, the *Pelagia* which lives in the north-eastern Atlantic should belong to *P. perla* Slabber, while the common Mediterranean form is *P. noctiluca* Forskål. They are distinguished by the nettle-warts which are small, rounded, and numerous in *P. perla*, large, elongate, elliptical in *P. noctiluca*; further by the dimensions of the manubrium, *P. perla* having a short mouth-tube (about $^1/_8$ the length of the bell-radius, *r*) and very long mouth-arms (3 *r*), whereas *P. noctiluca* has a longer mouth-tube (nearly as long as the bell-radius) and shorter mouth-arms (about 2 *r*). This means that in *P. perla* the mouth-arms would be about 6 times the length of the mouth-tube, in *P. noctiluca* only 2—3 times that length. If this were correct, distinction between the two species would be an easy task, even in specimens at different stages of contraction. But it is not so.

I have measured the diameter of the bell and the length of the mouth-tube and the mouth-arms in all specimens, more than 10 mm wide, and in a sufficiently good state of preservation. Altogether 59 Atlantic and 100 Mediterranean specimens were measured. I have, moreover, made notes of the shape of the nettle-warts in each specimen. The marginal lappets are subject to much variation in shape, and they

Table VIII. ***Pelagia noctiluca.*** **— Correlation between length of mouth-tube and mouth-arms in specimens from the Atlantic (ordinary types) and from the Mediterranean (italics).**

Length of mouth-tube	Length of mouth-arms, mm															
	10		20		30		40		50		60		70		80		90	
mm																		
4	..	*1*	..	..	..	..	..	..	..	..	..	..	..	..	..	..		
5	4	*2*	2	..	..	..	..	..	..	..	..	..	..	..	..	..		
6	7	*4*	1	*1*	..	*1*	..	..	..	..	..	..	..	..	..	..		
7	2	*2*	6	*6*	2	..	..	..	..	*1*	..	..	..	..	..	..		
8	..	*4*	3	*7*	1	*1*	1	..	..	..	..	..	..	..	..	..		
9	..	..	2	*3*	4	*2*	1	..	1	..	..	..	..	..	..	..		
10	..	..	1	*2*	..	*7*	1	..	..	..	1	..	..	..	..	..		
11	..	..	..	*1*	..	*1*	1	*2*	1	..	1	..	..	..	..	..		
12	..	..	..	*1*	..	*3*	2	*4*	..	*4*	..	..	..	..	..	..		
13	..	..	..	*1*	..	..	..	*2*	..	*1*	..	..	..	..	..	..		
14	..	..	..	..	..	*1*	..	*6*	..	*1*	..	*1*	1	..	..	..		
15	..	..	..	..	..	*1*	..	..	1	*2*	1	*1*	..	..	..	..		
16	..	..	..	..	..	..	..	..	1	*2*	1	..	..	..	..	..		
17	..	..	..	..	..	..	..	*2*	..	*2*	1	..	1	..	..	..		
18	..	..	..	..	..	..	..	..	1	*1*	..	*2*	..	*2*	1	..		
19	..	..	..	..	..	..	..	*1*	..	..	..	*1*	1	*1*	..	..		
20	..	..	..	..	..	..	..	..	..	*1*	..	..	..	*2*	..	*1*		
21	..	..	..	..	..	..	..	..	..	..	..	..	..	*1*	..	..		
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..		
23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..		
24	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..		
25	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	*1*		
Total	13	*13*	15	*22*	7	*17*	6	*17*	6	*15*	6	*5*	3	*6*	1	*2*		
Average	5.9	*5.9*	7.3	*8.5*	8.3	*10.5*	10.3	*13.7*	15.5	*14.4*	15.7	*16.8*	16.7	*19.3*	18.0	*22.5*		

are far from presenting any distinguishing character between the two "species". They are always about as long as wide, their corners more or less rounded. The outline of their outer margin is highly variable, exhibiting every transition from a slight incurvation to a deep cleft, the latter being either sharp or rounded at the bottom, Lappets of any different shape may be found in one and the same individual. — The nettle-warts are likewise highly variable both in number, size, and shape. Neither here have I been able to find any difference between the Atlantic and the Mediterranean form. There is a considerable individual variation, but, generally spoken, I have found that in small specimens the warts are small and rounded, whereas in large specimens they are large and elongated. In very large specimens several warts, placed in one radial row, frequently coincide, forming elongated mounds, radially placed, and several times longer than broad. Besides, the state of contraction of the bell plays a part: when the bell is flat, disk-like, the warts are generally rounded, when the bell is contracted, dome-like, the warts become more elongated. In some individuals the warts are so large that the specimen corresponds to *P. neclecta,* as described by VANHÖFFEN from the Mediterranean.

In order to elucidate the dimensions of the different parts of the manubrium (mouth-tube and mouth-arms) I have worked out the adjacent tables (tables VII—VIII). The correlation between the length of the mouth-tube and the bell-diameter is presented in table VII. The specimens examined are grouped according to size within limits of 10 mm. Within each column the specimens are grouped according to the length of the mouth-tube, the Atlantic specimens on the left hand side (ordinary types), the Mediterranean specimens on the right hand side (italics). The average length of the mouth-tube within each size-limit of bell-diameter is represented below. It will be observed that the average length of the mouth-tube is, in all instances, a little larger in the Mediterranean than in the Atlantic specimens, but in both cases the range of variation is very considerable. This means that when a sufficient number of specimens

are carefully examined we may distinguish between two geographical races of *Pelagia*. Thus far my results agree with the statements of the literature, but the difference has no specific value, and by examining a single specimen we can never determine which of the races it belongs to. — As regards the length of the mouth-arms in relation to the bell-diameter my results are in absolute contradistinction to the statements of the literature. As a matter of fact, I have found that the mouth-arms are longer in the Mediterranean than in the Atlantic specimens, but the difference is very slight. I do not, therefore, reproduce the entire table of correlation, but shall restrict myself to give the average length of the mouth-arms at the bottom of table VII. — As mentioned above, the most conspicuous difference between *Pelagia perla* and *noctiluca* should be found in the correlation between the length of the mouth-arms and the mouth-tube. Also in this instance, however, the slight difference which I find is of no value to specific distinction between the Atlantic and the Mediterranean form. Table VIII is constructed in much the same way as table VII only the grouping according to bell-diameter has been substituted by a grouping according to length of the mouth-arms, within limits of 10 mm.

Thus, a careful examination of 59 North-Atlantic and 100 Mediterranean specimens of *Pelagia* gives the following results: As regards the nettle-warts and the marginal lappets the two forms are completely alike, and I may add that the same holds good, as far as the absolute size of the individuals and the relative height of the bell are concerned. On an average, the mouth-arms and the mouth-tube, especially the latter, are just a little longer in Mediterranean than in Atlantic specimens of equal size. The specimens from the two geographical areas may represent two races which are, however, so much like each other that any doubt of their specific identity is absolutety excluded.

The expeditions of the "Thor" have found *Pelagia noctiluca* in two different regions, widely separated from each other, *viz.* in the Mediterranean, and in the Bay of Biscay and south of Ireland. The specimens from the two regions represent the above-mentioned two races, and as, besides, the biological habits are different I prefer in the following to deal with the occurrence in the two regions separately.

Table IX. Material of *Pelagia noctiluca*.

Atlantic.

No. of Station	Date	Position Lat. N.	Position Long. W.	Gear	Wire out, meters	Duration of haul, minutes	Diameter of specimens, mm ⩽ 10	10—20	20—30	30—40	40—50	50—60	60—70	70—80	80—90	Total number of specimens
	1905															
82	15. VI	51°00′	11°43′	?	?	?	..	1	..	..	..	..	..	..	..	1
88	20. VI	48°09′	8°30′	Y 200	300	?	..	2	10	8	1	1	..	..	..	22
92	24. VI	48°55′	12°20′	Y 330	300	60	..	..	..	..	..	..	2	..	1	3
	1908															
1	28. XI	49°17′	4°13′	Y 200	25	30	2	1	..	..	..	..	..	..	..	3
3	30. XI	47°45′	5°28′	—	65	30	401	10	..	..	..	..	..	..	..	411
	1909															
74	9. III	44°21′	7°55′	—	65	60	..	..	..	..	..	..	1	..	..	1
75	—	45°37′	7°03′	—	25	30	..	..	..	7	4	..	..	..	..	11
—	—	—	—	—	65	60	..	..	..	..	2	1	..	1	..	4
—	—	—	—	—	300	60	..	..	..	1	1	1	1	..	..	4
—	—	—	—	—	600	60	..	..	..	..	2	1	1	..	1	5
76	10. III	47°01′	5°48′	—	300	60	..	..	1	..	..	..	..	..	..	1
—	—	—	—	—	1600	60	..	1	..	..	..	..	..	..	..	1
	1910															
240	15. IX	44°34′	8°16′	—	25	15	..	..	..	..	..	1	1	3	..	5
—	—	—	—	—	300	15	..	..	..	..	..	..	1	1	..	2
—	—	—	—	—	1000	30	..	..	..	..	..	..	1	..	1	2
242	16. IX	46°19′	6°48′	—	65	15	..	..	..	..	..	1	..	..	..	1

Mediterranean.

No. of Station	Date	Position Lat. N.	Position Long. E.	Gear	Wire out, meters	Duration of haul, minutes	Diameter of specimens, mm < 10	10—20	20—30	30—40	40—50	50—60	60—70	70—80	80—90	Total number of specimens
	1909															
35	29. I	43°36′	7°36′	Y 200	25	60	..	..	..	..	..	..	..	1	..	1
	1910															
112	27. VI	36°56′	2°15′	—	25	15	1	..	..	..	..	..	..	..	..	1
120	1. VII	42°31′	7°41′	—	300	30	..	..	..	..	..	..	..	..	1	1
121	2. VII	43°08′	8°05′	—	25	30	1	1	1	..	..	..	..	..	..	3
123	3. VII	44°14′	8°55′	—	10	15	8	..	..	..	..	..	..	..	..	8
—	—	—	—	—	300	30	2	13	..	..	..	..	..	..	..	15
124	—	44°20′	9°05′	—	65	90	5	..	..	..	1	..	..	..	..	6
126	10. VII	42°43′	9°50′	—	25	30	11	..	..	..	1	..	..	..	..	12
129	12. VII	40°05′	11°31′	—	25	30	45	..	..	..	..	..	..	..	..	45
130	13. VII	39°35′	11°20′	—	25	30	3	..	..	..	..	..	..	..	..	3
131	—	38°36′	11°00′	—	300	30	..	2	..	1	..	..	..	..	..	3
—	—	—	—	—	1000	60	..	..	2	1	..	..	..	..	..	3
132	14. VII	38°57′	9°47′	—	25	30	1	..	..	..	..	..	..	..	..	1
—	—	—	—	—	300	30	4	..	..	..	..	..	..	..	..	4
—	—	—	—	—	600	30	..	3	..	..	..	..	..	..	..	3
133	—	38°18′	9°59′	—	300	30	4	..	..	..	..	..	..	..	..	4
—	—	—	—	—	600	30	6	..	..	..	..	..	..	..	..	6
141	20. VII	36°42′	13°34′	—	25	15	2	18	10	11	3	..	..	..	..	44
142	22. VII	35°44′	15°07′	—	25	30	..	..	2	..	..	..	..	..	..	2
—	—	—	—	—	150	30	..	..	8	11	1	..	..	..	..	20
143	23. VII	35°18′	16°25′	—	25	30	..	..	..	..	..	1	..	..	..	1
186	17. VIII	37°57′	19°51′	—	300	15	..	..	..	1	..	..	..	..	..	1
—	—	—	—	—	1200	30	..	..	..	1	..	..	..	..	..	1
189	19. VIII	37°44′	15°58′	—	300	15	..	..	..	..	..	1	..	..	..	1
192	20. VIII	38°07′	15°35′	—	25	15	..	..	1	..	..	..	..	..	..	1
—	—	—	—	—	600	30	..	1	..	..	..	..	..	..	..	1
193	21. VIII	38°15′	15°39′	—	10	30	..	..	..	..	3	..	..	..	..	3
196	22. VIII	39°59′	14°31′	—	25	30	..	..	1	..	..	..	..	..	..	1
199	25. VIII	39°32′	10°49′	—	25	15	1	..	..	..	..	..	..	..	..	1
—	—	—	—	—	300	20	..	..	..	2	1	1	..	..	..	4
200	26. VIII	39°18′	10°11′	—	25	30	..	2	1	..	..	..	..	..	..	3
209	29. VIII	40°34′	3°03′	C 200	35—0	..	..	3	..	..	..	..	..	..	..	3
—	—	—	—	Y 200	25	15	10	9	..	..	..	..	..	..	..	19
—	—	—	—	—	100	20	7	30	..	..	..	..	..	..	..	37
—	—	—	—	C 200	150	20	7	26	..	..	..	..	..	..	..	33
—	—	—	—	Y 200	300	15	4	16	..	..	..	..	..	..	1	21
—	—	—	—	—	1000	45	1	4	..	..	..	..	..	..	..	5
—	—	—	—	—	2000	45	3	9	..	..	..	..	..	..	..	12
210	30. VIII	41°10′	2°23′	Y 200	25	30	3	..	..	..	..	..	..	..	..	3
—	—	—	—	—	600	30	19	12	1	..	..	..	..	..	..	32
	1911															
274	3. IV	39°30′	14°20′	S 200	94	30	..	..	..	..	..	2	..	1	1	4
275	—	39°05′	14°50′	—	94	30	..	..	..	..	..	..	1	..	..	1
276	4. IV	36°30′	19°20′	—	132	35	..	..	..	..	..	..	..	1	..	1
339	20. VIII	40°30′	3°10′	—	28	30	..	..	..	..	4	7	7	2	..	20
—	—	—	—	S 150	90	30	..	..	..	1	..	2	6	2	1	12
340	26. VIII	35°50′	21°30′	S 200	28	30	1	..	..	..	..	..	..	..	..	1
341	27. VIII	34°00′	26°20′	S 150	108	30	29	..	..	..	..	..	..	..	..	29

Abbreviations: Y 200 Young-fish trawl, 200 cm in diam. at opening.
C 200 Ring-trawl, 200 cm in diam. at opening.
S 150 Stramin-net, open, conical, 150 cm in diam. at opening.
S 200 Stramin-net, open, conical, 200 cm in diam. at opening.

Distribution in the Atlantic.

Pelagia phosphora from the tropical Atlantic is probably identic with the North-Atlantic form of *Pelagia noctiluca* (= *P. perla* Slabber). Broch (1911, p. 21) points out that "the medusa was rather scarce through the soutern part of the route of the "Michael Sars"". It was found abundantly at the Azores and in the North-Atlantic between the Newfoundland Bank and the Bay of Biscay, but with one exception (at one station in the Cadiz Bay) none were found off the western coasts of Europe and Africa between Cape Finisterre and the Canary Islands. Neither did the "Thor" find any specimens of *Pelagia* between the Bay of Biscay and the Strait of Gibraltar. Thus, the tropical and the North-Atlantic stocks of *Pelagia* seem to be separated by an area in which the species is very scarce. The medusa is very common in the Bay of Biscay ranging into the Channel and along the western coasts of the British Isles as far north as Lat. 57°—58° N. Vanhöffen has seen a big shoal West of the Rockall Bank (Vanhöffen, 1906, p. 45), and in July 1889 the Plankton-Expedition found a specimen north of the Hebrides (Lat. 58° 30′ N.).

Among the material, collected by the "Thor" are a number of specimens, found in June 1905 south-west of Ireland. During the expeditions of 1908—10 the species was found at several stations between the western part of the Channel and the southern part of the Bay of Biscay. The bulk of the specimens were found between 200 m and the surface, but a few were taken at considerable depths (with 1000—1600 m wire out). The size of the individuals stands in no obvious relation to the depth in which they were found.

Table X. *Pelagia noctiluca*.
Size of individuals at different seasons.

Atlantic.

Month	Diameter of specimens, mm.			
	3—10	10—20	20—50	50—90
November	403	11	0	0
March	0	1	18	8
June	0	2	20	4
September	0	0	0	10

Mediterranean.

Month	Diameter of specimens, mm.			
	3—10	10—20	20—50	50—90
July	91	37	54	1
August	85	109	18	29
January	0	0	0	1
April	0	0	0	6

Seasonal occurrence.

Pelagia is a holoplanktonic medusa without a fixed scyphostoma stage. — The specimens from the Atlantic were collected at four different seasons, though in different years, and they give a very good picture of the seasonal occurrence of the species in that region. If the specimens are classified into four groups according to size (bell-diameter) within the months of November (1908), March (1909), June (1905), and September (1910), we will observe (table X) a gradual increase in size from November (when only small individuals are found) through March and June (when middle-sized specimens are prevailing) to September (when only large individuals are present). The table shows that in the Bay of Biscay and adjacent waters *Pelagia noctiluca* has a well marked breeding time (in the autumn) and that the entire development of the individuals takes about a year.

Distribution in the Mediterranean (see Chart XII).

Carus (1884, p. 51) records *Pelagia noctiluca* from the following localities in the Mediterranean: Majorca, Nice, Genoa, Naples, Messina, Sicily; he adds that the species seems to be missing in the Adriatic Sea, and it is not mentioned by Graeffe (1884) from the Gulf of Trieste. — According to Lobianco (1888, p. 393) mature specimens occur in the Gulf of Naples all through the year, being particularly numerous during the winter. Ephyræ are found in great abundance from November to March. In 1899 (p. 464) Lobianco repeats these statements but adds that the medusa has become very scarce in the Gulf in the course of the later years for no obvious reason.

Neither by the "Thor" nor by previous investigations was *Pelagia* found in the Alboran Sea. The "Thor" found a single, very small specimen near Algiers (stat. 112), and this is the only find of *Pelagia* from the southern part of the Balearic Sea. The medusa was found abundantly north of the Balearic Isles in August 1910 and 1911. It moreover occurred in several localities west and north of Corsica, in the Tyrrhenian Sea, the Strait of Messina, the Sidra Sea, the Ionian Sea, and south of Crete. It was, however, missing in the southern part of the Sidra Sea, as also in the Ægean Sea.

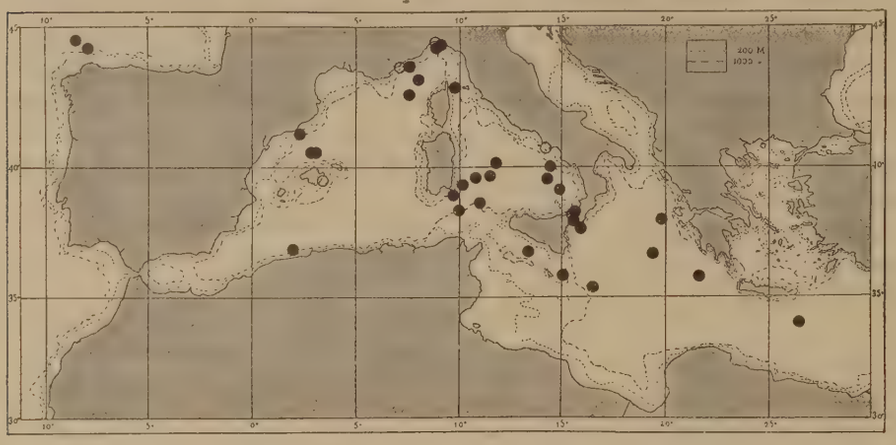


Chart XII. ● Finds of *Pelagia noctiluca* (Forsk.), ○ occurrence in the Mediterranean according to the literature.

As in the Atlantic the bulk of the specimens were found between about 200 m and the surface, some few being caught further down. At stat. 209, north of the Balearic Isles, 12 small specimens were taken in a haul with 2000 m wire out; it seems probable, however, that these specimens were really caught during the hauling in of the net through the upper strata, where the medusa was abundant. The size of the individuals seems to be independant of the depth in which they were found.

Seasonal occurrence in the Mediterranean.

As regards seasonal occurrence the facts are not so simple in the Mediterranean as in the Bay of Biscay, and the results, derived from the present material, are in absolute opposition to the statements of Lobianco (see above). Whilst Lobianco found mature specimens particularly abundant in the Gulf of Naples during the winter, and ephyræ in great numbers from November to March, only one single individual of *Pelagia* was found by the "Thor" during the winter cruise in the Mediterranean. It was a large specimen (75 mm wide) and it occurred in the surface layers near Monaco (stat. 35) at the end of January. In April 1911 the "Pangan" took a number of large specimens in the Tyrrhenian and the Ionian Sea. — During the summer cruise of 1910, on the other hand, *Pelagia* was found in great numbers in the Mediterranean in July and August, and specimens of any size were present. Very large individuals were, however, somewhat scarce, but in August 1911 the "Pangan" found several large specimens north of the Balearic Islands (stat. 339). — Table X (p. 51) presents the number of specimens of different size-classes, found at the various seasons from which material is to hand. It will be seen that young specimens were missing in January and April, but were abundant in July and August. As, however, middle-sized and fairly large specimens were plentifully represented at the same time of the year we may conclude that young specimens must also have occurred at the preceding time, probably during several months before July. *Pelagia*, accordingly, has a very extended breeding time in the Mediterranean. If Lobianco is right that ephyræ are numerous during the winter, I cannot comprehend why no young specimens were found during the winter cruise of the "Thor". And as, in any case, breeding takes place during spring and sumıner, it is just as incomprehensible that large specimens were missing in winter.

34. AURELIA AURITA (L.).

(Fig. 38).

Material.

Stat. 171. Lat. 41°07′ N., Long. 29°05′ E. 10. VIII. 1910. Depth 50 m.
Y. 50 m wire, 1 specimen, diam. 6.5 cm.
Stat. 172. Lat. 41°32′ N., Long. 29°24′ E. 11. VIII. 1910.
Y. 50 m wire, 8 specimens, diam. 4, 4, 5, 5, 6, 6, 11, 16 cm.
Y. 100 m wire, 6 specimens, diam. 7, 7, 9, 9, 10, 14 cm.
Stat. 173. Lat. 41°17′ N., Long. 29°11′ E. 11. VIII. 1910. Depth 65 m.
Y. 65 m wire, 1 specimen, diam. 4 cm.

This widely distributed neritic medusa occurs, probably, along all the Mediterranean coasts. CARUS (1884) records it from the following localities: Nice, Naples, Sicily, Trieste, Alexandria, and the west coast of Asia Minor. According to GRAEFFE (1884), large specimens are found in the Adriatic from February to March or April, sometimes as late as in June. All the specimens of *Aurelia* brought home by the "Thor" are from the Bosphorus and the adjacent part of the Black Sea where some specimens were collected on Aug. 10.—11. 1910, ca. 30—65 m below the surface. None of the specimens are fully mature, and part of them are rather small. They all belong to the typical form of *Aurelia aurita*. The 8 marginal incisions of the disk are very faint. The oral arms are somewhat shorter than the radius of the disk. The 8 adradial canals are totally unbranched and without connection with the other canals which are faintly ramified, and anastomoses between the branches are very rare. The number of primary canals issuing from each genital sinus cannot, as a rule, be decided, at any rate, not in the larger individuals, where this character is of the greatest interest.

Fig. 38. *Aurelia aurita* (Linné). — From Mayer 1910, specimen from Naples.

35. COTYLORHIZA TUBERCULATA (Macri).

(Fig. 39).

Material.

Smyrna, 3. VIII. 1910.
1 specimen, diam. 14 cm.
Stat. 182. Lat. 38°13′ N., Long. 24°48′ E. 13. VIII. 1910.
Y. 10 m wire, 1 specimen, diam. 2.7 cm.
Stat. 209. Lat. 40°34′ N., Long. 3°03′ E. 29. VIII. 1910.
2 specimens, diam. about 6 cm.

Further Distribution.

Mediterranean: Nice, Genoa, Rapallo, Naples, Messina, Trieste, Lesina, Ægean Sea (CARUS 1884, p. 54). Near Elba, Sept. 30. 1892, at the surface (MAAS 1904 a, p. 59). According to GRAEFFE (1884, p. 343), this medusa only occurs in the Adriatic Sea in July, August, and September; in some years it is not found at all. — In the Gulf of Naples young specimens appear in July or August, and large specimens occur until November, more rarely until December or January (LOBIANCO 1888, p. 393; 1899, p. 463).

Outside the Mediterranean: If MAYER (1910, p. 659 ff.) is right in stating that *Cotylorhiza ambulacrata* Haeckel is identical with *C. tuberculata*, the species has been found at the Canary Islands. — According to VANHÖFFEN (1888, Bibliotheca Zoologica, Bd. I, Heft 3, pp. 27, 40), a young specimen was found near Arsak in the southern part of the Read Sea in June 1885.

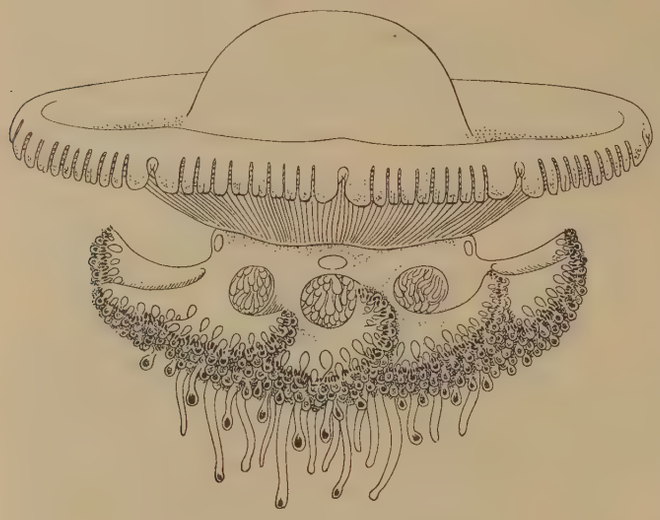


Fig. 39. *Cotylorhiza tuberculata* (Macri). — From Mayer 1910, plate 73, fig. 2.

It will be seen from the records of the literature that this medusa has a wide distribution in the coastal areas of the Mediterranean, but it only occurs during a comparatively short period. It has been assumed (KELLER 1884, LOBIANCO 1888) that the species really is a deep-sea medusa which is only occasionally carried into the coastal water. This, I think, does not hold good. First, because ephyræ and young medusæ as well as full-grown specimens have been found within the same areas, secondly, because of the distinguished regularity of its time of occurrence (cfr. GRAEFFE and LOBIANCO); and besides, if this species, which must be fairly abundant in the Mediterranean, belonged to the deeper strata, we might expect it to have been caught there by the "Thor". But, as a matter of fact, the few specimens, found by the "Thor", were taken near the surface in the coastal regions.

II. GENERAL PART.

The material of medusæ, collected by the "Thor", and dealt with in the present paper, comprises 35 species, belonging to the following groups:

Hydromedusæ		
Anthomedusæ	8	species
Leptomedusæ	6	—
Trachymedusæ	11	—
Narcomedusæ	4	—
Scyphomedusæ	6	—

One species (*Gossea corynetes*) was only found in the English Channel. — Among the 17 species, found by the "Thor" in the Atlantic (between the south coast of Ireland and the north coast of Morocco) 7 species do not enter the Mediterranean (mostly deep-sea forms). — In the Mediterranean with adjacent seas 27 species were found. Two of these (*Merga lobianci* and *Liriope mucronata*) seem to be endemic in the Mediterranean, and three other species (*Köllikeria fasciculata, Pandea conica,* and *Mitrocoma cirrata*) were hitherto only known from the Mediterranean, but are now found to occur in the Cadiz Bay. To these latter might be added *Octocanna funeraria* which was not before recorded in the literature from out-

side the Mediterranean, but of which I may state here that it is, in fact, very common in some of the deep fiords on the west coast of Norway.

No species, new to science, was secured, but the collections of the "Thor" have to a considerable degree increased our knowledge as to the geographical distribution of the species. Among the 27 species from the Mediterranean only one (*Homoeonema conica*) was not known to occur there beforehand, but several species, hitherto known from but a few localities, were found to be widely distributed in the Mediterranean.

I shall now enter on a description of the medusan fauna of the different areas investigated, and will try to discuss the connection between the occurrence of the species and the hydrographical conditions, as they have been set forth by J. N. Nielsen in the first volume of this Report (1913).

MEDITERRANEAN.

Most of the collections of the "Thor" were carried out in offshore localities; the material, therefore, contains comparatively few neritic forms from few and scattered localities. They are, accordingly, of no great importance to a general faunistic discussion, and may as well be mentioned separately.

Neritic species.

Merga lobianci. — It may be doubtful whether this species is really neritic, as Lobianco found it in deep water in the Gulf of Naples. The "Thor" found it near the surface, in different coastal areas.

Leuckartiara octona. — This species, hitherto unknown from the western basin of the Mediterranean, was found by the "Thor" in the Sea of Marmora. It furthermore occurred in the Alboran Sea in June.

Neoturris pileata. — The "Thor" only found this species in the Alboran Sea in June. Most other records from the Mediterranean are from the winter and early spring.

Laodicea undulata. — Found in the Alboran Sea in June, and north of the Baleares in August.

Mitrocoma cirrata. — Only found in the Alboran Sea (and in the Cadiz Bay) in June.

Phialidium hemisphæricum. — Found, for the first time, in the Sea of Marmora; also in other coastal areas, but very sparingly.

Eirene viridula.

Aequorea forskålea.

All the above-mentioned species (except perhaps *Merga lobianci*) have, or may be supposed to have a littoral hydroid stage. The Trachy- and Narcomedusæ are holoplanktonic forms of oceanic habits. Among the Scyphomedusæ two species shall be mentioned in this connection:

Cotylorhiza tuberculata has been supposed to be a deep-sea form, which I think is not correct (see above p. 54).

Aurelia aurita is a true neritic medusa with a littoral scyphostoma stage. The "Thor" missed it in the Mediterranean but found it in the Bosphorus, and it was the only medusa met with in the Black Sea, where it occurred from about 25 to 50 m below the surface, *i. e.* in water of 18—20 ‰ salinity, whereas it was completely wanting in the inflowing Mediterranean water. This indicates that the medusæ in question have been liberated from scyphostoma stages growing at the shores of the Black Sea.

Nausithoë punctata has a littoral scyphostoma stage, but the medusa is not strictly neritic, and I prefer, therefore, not to mention it in this place.

Most neritic hydromedusæ were found in the Alboran Sea and in the Strait of Gibraltar together with other surface water species, but only in June, not in February or September. This peculiarity will be further discussed below.

Ægean Sea and Sea of Marmora.

Besides the neritic medusæ already mentioned, the following species were found in the Sea of Marmora and the Ægean Sea:

Sea of Marmora: *Pandea conica* and *Liriope eurybia.*

Ægean Sea: *Oceania armata, Pandea conica, Octocanna funeraria, Rhopalonema velatum, Liriope eurybia,* and *Nausithoë punctata.*

With the exception of *Octocanna funeraria,* of which 2 specimens were found near Piræus (stat. 18) in December 1909, these species were all met with in the Levant. — *Pandea conica* and *Nausithoë punctata* were very rare, but the other species are of considerable interest, as regards their connection with the hydrographical conditions, the more so because they belong to different water layers.

During the winter cruise of 1909 only the Gulf of Ægina was examined, but in August 1910 the "Thor" followed the west coast of Asia Minor from Rhodes to the Dardanelles, went into the Sea of

Fig. 40. Currents of the Mediterranean (from J. N. Nielsen, 1913).
Direction of movement: ⟶ of the surface water, ⇢ of the intermediate water.

Marmora, and finally crossed the Ægean Sea from the Dardanelles to the Gulf of Ægina, carrying out a great number of hauls with the young-fish trawl in all parts of the route.

Oceania armata is not uncommon in the intermediate water layers in the Levant (about 150—600 m below the surface). It was found in all depths at stat. 163 off the west coast of Asia Minor (south of Scios), whereas it was completely missing at stat. 182 on the opposite (western) side of the same basin of the Ægean Sea. In the uppermost 300 m the salinity of the water is somewhat lower at stat. 182 than at stat. 163, but from 300 m downwards the hydrographical conditions are practically identical. If *Oceania armata* were indigeneous in the Ægean Sea, we might, accordingly, expect it to occur in the intermediate strata in both localities. Its missing at stat. 182, therefore, indicates that the species is only a visitor in the Ægean Sea, carried in by a current from the Levant along the west coast of Asia Minor. Nielsen has proved the existence of a northgoing surface-water current along the said coast, but he does not expressly state that the intermediate strata take part in this movement. There is, however, no reason to believe that this is not the case, and the distribution of *Oceania armata* in the Ægean Sea greatly confirms that supposition. In the eastern part of the Ægean Sea the surface water has a very high salinity (about 39 ‰), and an extensive vertical circulation of the water takes place. In accordance herewith *Oceania armata* is found at stat. 163 considerably nearer to the surface (25 m wire) than in any other place in the Mediterranean.

Rhopalonema velatum has a very extensive vertical distribution, but is mainly found between 150

and 200 m below the surface. It was found at most stations in the Ægean Sea, and may be indigenous in that sea. It follows the cyclonic circulation of the water along the shores of the Ægean Sea, but it does not surpass the threshold of the Dardanelles nor does it occur in the Sea of Marmora. The species was particularly common at stat. 179 (depth 85 m) just outside the Dardanelles, in a haul with 65 m wire (about 40 m below the surface), but the haul made in the same depth at stat. 178 in the Dardanelles did not contain a single specimen. At stat. 163 the main part of the specimens of *Rhopalonema velatum* were found more than 150 m below the surface. The accumulation of the medusa in 40 m' depth at stat. 179 indicates, accordingly, that the water masses by which this species is carried northwards along the west coast of Asia Minor, rise somewhat towards the surface outside the mouth of the Dardanelles, where they come to a stop. As, on the other hand, *Liriope eurybia*, which is a more pronounced surface water species, is freely admitted into the Sea of Marmora, we may state that the salt undercurrent, running from the Ægean Sea through the Dardanelles into the Sea of Marmora, is only derived from a comparatively thin layer of water from the surface of the Ægean Sea, whereas the intermediate water layers of the latter are entirely excluded. This is in very good accordance with the hydrographical observations made by the "Thor". If we look at fig. 4 (p. 115) in NIELSEN's paper, we shall find that the isohaline of 38.8 ‰ just touches the bottom at a depth of 50 m in the Dardanelles (stat. 177), but rises considerably towards the surface (32 m) outside the Straits.

In contradistinction to the above-mentioned two species, *Liriope eurybia* mainly belongs to the upper strata. It was found almost everywhere in the Ægean Sea, being fairly common in the eastern part, and it was exceedingly numerous in the Sea of Marmora. As the species is not particularly abundant in the Ægean Sea, this enormous quantity in the Sea of Marmora needs an explanation. It is very probable that the medusa may live in the Sea of Marmora for a long time and pass its whole life-cycle there, (specimens of every size from 2 to 8 mm wide were found), but it is besides to be supposed that a fresh supply takes place from the upper water layers of the Ægean Sea during a very long period of the year (as to the seasonal occurrence of the species see p. 33). Let us try to follow the fate of these imported specimens! In the Ægean Sea (as in other parts of the Mediterranean) the medusa keeps mainly to the strata between 15 and 50 m below the surface. At the entrance to the Sea of Marmora this water dives down below the outflowing surface-current of fresher water (salinity about 25 ‰) and sinks into greater depths in the Sea of Marmora. At stat. 175 (in the middle part of that sea, depth 1103 m) several hundreds of specimens of *Liriope* were found in hauls with 100, 400, and 1200 m wire out, but we do not know how many of these specimens were really caught in these considerable depths. In any case, on account of the general habit of the medusa, the main part of the specimens ascend as far upwards towards the surface as possible, *i. e.* to the boundary layer between the salt Mediterranean water and the thin surface layer of fresher water coming from the Black Sea. Here, about 20 m below the surface (35 m wire out), a 15 minutes' haul with the young-fish trawl caught about 10000 specimens, rougly calculated. A haul in the surface layer (10 m wire out) caught no specimens at all. Undoubtedly the uppermost part of the Mediterranean water masses are, by friction, carried westwards together with the Black Sea water, and the *Liriope* medusæ are thus carried backwards into the Dardanelles where we find them at stat. 178. Already here the fresh surface layer becomes somewhat less thick by a mixture with the salt water of the Ægean Sea, and the strong movements of the water forcing its way through the narrow and shallow straits probably result in various complicated circulations and whirls carrying some of the medusæ closer to the surface than normally. In accordance herewith we find quite a number of *Liriope* in a haul with 10 m wire out (88 specimens in a 15 minutes' haul). But why was the species so scarce at stat. 179 just outside the Dardanelles? Here the fresh surface layer has, apparently, entirely disappeared, *i. e.* it spreads along the surface of the Ægean Sea and quickly becomes mixed with the salt water. Now *Liriope* does not normally occur less than 15 m or more below the surface, and if, at the mouth of the Dardanelles, the medusæ seek these depths, they once more come into the strata which are moving inwards towards

the Sea of Marmora, and are thus brought back into that sea to take part in the same circulation over and over again, as long as they live, and if they are able to breed in the Sea of Marmora, their successors will continue in the same manner. Supposing this explanation to be correct we may better understand the peculiar distribution of *Liriope eurybia* in this region: the medusa being fairly common in the eastern part of the Ægean Sea, exceedingly numerous in the Sea of Marmora, and rare in the western part of the Ægean Sea. In short, I think that the Sea of Marmora acts as a trap to the medusæ, receiving a moderate but continuous supply from the Ægean Sea, and practically never letting any of them out again. As *Liriope* was abundant 40 m below the surface at stat. 174 near the entrance to the Bosphorus, it seems probable that some specimens may be carried through the Bosphorus into the intermediate waters of the Black Sea. The species was not found there by the "Thor", but unfortunately no pelagic fishing was carried out in deeper strata at the stations in question.

Mediterranean, eastern basin[1].

In the intermediate strata of the Levant (between Egypt and Rhodes, stat. 156, 158, and 160) the predominant species of medusæ were (in July 1910) *Oceania armata* and *Rhopalonema velatum*. The former was found in every haul with 300—1000 m wire out, particularly abundant at stat. 158, midway in the basin. *Rhopalonema velatum* ascends somewhat more towards the surface, where, moreover, *Liriope eurybia* was found. The latter species was particularly common at stat. 160 south of Rhodes in the salt surface water current, which here rounds the south-west corner of Asia Minor and continues into the Ægean Sea. Also a few specimens of *Pandea conica* occurred in this water-mass, and in the deepest haul at the same station (1000 m wire) a specimen of *Bythotiara murrayi* was found.

The middle part of the Ionian Sea was remarkably poor in medusæ, both in the winter (stat. 11) and in the summer (stat. 186, 187, and 189), only a few *Pelagia noctiluca* being found in the intermediate strata of stat. 186 and 187.

The Gulf of Sidra, on the other hand, contained quite a number of species. In hauls with 25 m wire out (above the stratum with minimum of salinity, caused by the east-going current) occurred *Rhopalonema velatum*, *Liriope eurybia* and *Nausithoë punctata*, at the southernmost station (147) also *Merga lobianci* and *Pandea conica*. About 150—200 m below the surface *Rhopalonema velatum* was common, and at stat. 147 a few specimens of *Oceania armata* were found in the same depth.

We will now regard the series of stations from stat. 156 (off the coast of Egypt) westwards through the southern parts of the Levant and the Ionian Sea to the Pantellaria Channel between Tunis and Sicily (section 5 of Nielsen's paper, comprising the stations 156 and 154 in the Levant, 152, 144, and 143 in the Ionian Sea, 142 and 141 in the Sidra Sea, and 138 midway in the Pantellaria Channel, all from July 1910). The "bottom water" in the Levant and the Ionian Sea has a salinity of 38.64—38.66 ‰, upwards gradually passing into the intermediate stratum which has a maximum of salinity (38.7 —> 38.8 ‰) some hundred meters below the surface. The water layer with more than 38.7 ‰ salinity has a thickness of about 700 m at stat. 156, gradually tapering westwards, but is still found in the Sidra Sea. Its upper limit is found about 150 m below the surface and varies only slightly. The main part of the intermediate stratum is moving westwards, very slowly and with only slight deflections until it turns round the west point of Sicily and enters into the Tyrrhenian Sea. — Above this stratum flows the less saline water of what we might call the "Atlantic current", consisting mainly of Atlantic water coming from the Strait of Gibraltar, flowing quickly eastwards along the north coast of Africa, gradually increasing in salinity and decreasing in thickness as it approaches the Levant. In the eastern part of the section it is overlayered by a thin stratum of very high salinity (caused by the strong evaporation from the surface). — The thickness of the "Atlantic current" is somewhat variable, "but at places it may reach

[1] As to the boundaries of the different regions, see Johs. Schmidt: Introduction, in vol. I of this Report, fig. 10, p. 15.

down to 200 m in the neighbourhood of the coast, from which the thickness decreases out towards the middle of the basin" (NIELSEN, p. 134). Thus the current is not limited to the less saline water layer, but, in certain places at least, comprises the uppermost part of the subjacent salt layer. — Now we shall see what the medusæ can tell us about this matter.

From the true "bottom water" we have only two hauls with the young-fish trawl, both from stat. 144 (Ionian Sea, depth of the bottom 3340 m); a haul with 2000 m wire out brought up a young specimen of *Pandea conica*; in the haul with 4000 m wire no medusæ were caught.

As pointed out above, *Oceania armata* is common in the intermediate strata of the Levant. This species was found in almost every intermediate haul (300, 600, and 1000 m wire out) in the eastern part of the section, as far westwards as stat. 152. Thus it confirms the supposition of the westward movement of the intermediate water layers from the Levant into the Ionian Sea. There is, however, reason to believe that the water in about 175 m at stat. 152 was really moving towards the east (see below), and nevertheless a specimen of *Oceania armata* was found here. But at stat. 152, special hydrographical conditions probably exist. Although this locality is very near by land (north coast of Barka), the depth of the bottom exceeds 2000 m. The coastal slope, accordingly, is very steep and may easily be supposed to cause certain vertical movements of the water by which *Oceania armata* is carried from the westgoing intermediate water into the lower part of the eastgoing water masses above. This supposition is confirmed by the occurrence, in the same haul (300 m wire out) of *Solmissus albescens* which is, undoubtedly, a deep-sea species (see p. 39).

When we follow the intermediate stratum further westwards, the most striking feature is the increasing number of *Rhopalonema velatum*. This species has a very wide horizontal as well as vertical distribution in the Mediterranean, with a well pronounced maximum between 150 and 200 m below the surface. In the summer of 1910 the medusa was particularly numerous in the waters west and north of the Pantellaria Channel, whereas it was rather scarce in the Levant. The number of specimens per one hour's haul with the young-fish trawl with 300 m wire out (about 175 m below the surface) in the western part of section 5 was as follows:

Stat.	138	143	144	152.
Number of specimens	350	154	86	28.

At the three last-named stations the depth, in which the hauls were made, coincides with the upper limit of the intermediate, salt water layer (the 38.7 ‰ isohaline). The gradual decrease in number of *Rhopalonema velatum* in this depth, from the Pantellaria Channel to the north coast of Barka, makes it highly probable that the said water layer takes part in the eastward movement of the surface water.

As regards the medusæ of the surface layers in section 5, I shall call special attention to *Liriope eurybia*. This species was very sparingly occurring at the stations in the Levant and in the Ionian Sea, and it was altogether missing in the Pantellaria Channel as also in the entire Balearic Sea. But at stat. 142 (in comparatively shallow water, 98 m, off the south-east point of Sicily) quite a number of specimens were found in hauls with 25 and 150 m wire out. In this locality the inflowing water of less than 38 ‰ salinity reaches right down to the bottom, and there is an isolated, intermediate mass of water with a salinity even below 37.5 ‰. This minimum is considered (by NIELSEN) to be due to the outflow of surface water from the Adriatic Sea, following the eastern coasts of Calabria and Sicily and continuing southwards into the Sidra Sea, where it joins the "Atlantic current". Now, *Liriope eurybia* is very common in the Strait of Messina; the specimens found at stat. 142, the most abundantly in the uppermost haul within the minimum of salinity, have therefore, undoubtedly, come from the east coast of Sicily, from which they were carried away by the coastal current.

At stat. 142 were likewise found a considerable number of small and middle-sized specimens of *Pelagia noctiluca*. This species was, however, the most plentiful in the deepest haul (150 m wire). Some

of the specimens may have come by the same route as *Liriope*, but the main part certainly originated further westward, the species being very abundant in the surface layers at stat. 141, south of Sicily.

Before we leave the eastern basin of the Mediterranean, I shall say a few words about some of the areas adjacent to the Ionian Sea. — In December 1908 the Gulf of Taranto and the southern part of the Adriatic Sea were examined by the "Thor", and several hauls were made with the young-fish trawl, but no medusæ were brought home from this region. — In the Gulf of Corinth the young-fish trawl was used in two localities in August 1910. At stat. 185 (in shallow water at the entrance to the gulf) no medusæ were found. At stat. 184, about midway in the gulf, the haul in the bottom-water (1000 m wire) caught no medusæ; in the less saline surface-water (38.15—38.25 ‰) two hauls, with 10 and 65 m wire out, brought up some specimens of the two meroplanktonic surface-water species *Merga lobianci* and *Nausithoë punctata*.

Mediterranean, western basin.

The eastern and the western basins of the Mediterranean are communicating through two different passages: the Pantellaria Channel and the Strait of Messina. The latter is a narrow and comparatively shallow sound (greatest depth about 100 m) which does not allow the intermediate water masses to pass unhindered from one basin into another. Bathypelagic organisms have, however, frequently been recorded as occurring in the upper strata in the Strait of Messina, and they were considered to prove a rise of the deeper water layers towards the surface as they forced their way through the straits. Nielsen thinks such considerable vertical movements of the water in the Strait of Messina most improbable, and, as a matter of fact, during the investigations of the "Thor" no traces of such a phenomenon were found, neither in the hydrographical observations nor in the composition of the medusan fauna. This does, however, not necessarily exclude the possibility that such an ascent of intermediate water masses may happen occasionally. The surface-water of the Strait of Messina runs to and fro (mainly tidal currents) and contains quite a number of medusæ. In August 1910 and February—March 1911 the following species were found: *Pandea conica, Rhopalonema velatum, Liriope eurybia, Geryonia proboscidalis, Cunina rubiginosa, Nausithoë punctata*, and *Pelagia noctiluca*, all species belonging to the surface-water or the upper part of the intermediate water layers.

The other passage between the eastern and the western basins of the Mediterranean, the Pantellaria Channel, is characterized by the shallow banks, stretching northwards from the coast of Tunis, which, in connection with the deflecting power of the earth's rotation, force the outflowing intermediate water towards north and east into the Tyrrhenian Sea where it flows along the north coast of Sicily and the west coast of Italy, whence it partly spreads into the deep, middle part of the Tyrrhenian Sea. There is no direct outflow of intermediate water-masses from the Sidra Sea into the Balearic Sea.

The surface-water of the Pantellaria Channel consists of the comparatively fresh water of the "Atlantic Current" which, before entering the Sidra Sea, sends off a branch into the Tyrrhenian Sea along the north coast of Sicily. This water contains very few medusæ.

The triangular area between the north coast of Tunis, the west point of Sicily, and the south point of Sardinia was thorougly examined in July 1910. As far as the medusan fauna is concerned, the intermediate water layers of that area were characterized by the great numbers of *Rhopalonema velatum*, particularly in the strata between 150 and 400 m below the surface. Towards Sardinia also a number of young specimens of *Pelagia noctiluca* were found.

The distribution of the medusæ in the Tyrrhenian Sea is very peculiar; the southern part of the basin contains a considerable number of species, whereas in the northern part (north of the latitude of Naples) very few medusæ were found by the "Thor". This becomes especially evident when we consult the maps in the present paper, displaying the horizontal distribution of the more important species. The peculiar distribution of the medusæ, particularly the great number of species found along a line across the Tyrrhenian Sea, from the Gulf of Naples to the south point of Sardinia, seems to confirm the

supposition, set forth by Nielsen, that parts of the water-masses (surface- as well as intermediate strata), moving northwards along the west coast of Italy, branch off towards the west, and, having reached the eastern slope of Sardinia, turn around the southern end of that island into the Balearic Sea.

The following species of medusæ were found by the "Thor" in the Tyrrhenian Sea: *Merga lobianci, Pandea conica, Bythotiara murrayi, Rhopalonema velatum, Homoeonema conica, Liriope eurybia, Geryonia proboscidalis, Cunina rubiginosa, Solmissus albescens, Periphylla hyacinthina, Nausithoë punctata, Pelagia noctiluca.*

A special problem is offered by the apparent ascent towards the upper water-layers of certain deep-sea forms, such as *Solmissus albescens* and *Periphylla hyacinthina*. A discussion of this problem had, however, better be postponed till an examination of the medusan fauna of the Balearic Sea and adjacent areas has been undertaken.

Besides the Strait of Bonifacio, through which only the surface-water is allowed to pass, there are two outlets from the Tyrrhenian Sea into the Balearic Sea. — A comparatively small part of the water masses, running northwards along the west coast of Italy, enters the Ligurian Sea, keeping mainly to the northern border areas of the latter, and continuing westwards into the Golfe du Lyon. The central part of the Ligurian Sea seems to be as poor in medusæ as the northern part of the Tyrrhenian Sea. In the coastal region (stat. 123, 124, and 35) a few specimens of *Aequorea forskâlea* and *Pelagia noctiluca* were found. At stat. 35 (January 1909) also a number of specimens of *Rhopalonema velatum* and *Solmissus albescens* occurred in a haul with 200 m wire out (see below).

The main outflow from the Tyrrhenian Sea takes place south of Sardinia. The outflowing water masses (surface- as well as intermediate layers) turn abruptly round the south-west corner of the island, proceeding northwards into the northern part of the Balearic Sea and then westwards into the Catalonian Sea. — None of the numerous medusæ occurring off the east coast of Sardinia (see above) are carried into the Balearic Sea by that current, which must, accordingly, be supposed to keep clear of the coastal area outside the east coast of Sardinia. The only species, met with by the "Thor" south and south-west of Sardinia (stat. 202 and 204), is *Rhopalonema velatum* which occurs here as abundantly as in the above-mentioned triangular area north of Tunis. This also holds good as to the entire central part of the Balearic Sea, where *Rhopalonema velatum* is, in fact, practically the only representative of the medusæ in the intermediate strata. Only at considerable depths (1000—2000 m wire) we also find *Bythotiara murrayi* and *Periphylla hyacinthina*.

In the Catalonian Sea we find the entire medusan fauna of the Balearic Sea accumulated within a narrow space. In August 1910 the following species were found at stat. 209 and 210 between Minorca and Barcelona, in the surface-water (25 m wire): *Laodicea undulata, Aequorea forskâlea, Liriope eurybia, Nausithoë punctata*, and *Pelagia noctiluca*; in the intermediate strata (100, 150, 300, and 600 m wire): great numbers of *Rhopalonema velatum* and *Pelagia noctiluca*, but no other species; in the two deepest hauls (1000 and 2000 m wire): the last-named two species still common, and besides: *Bythotiara murrayi, Octocanna funeraria, Homoeonema conica*, and a specimen of *Cunina rubiginosa* (the latter was most probably caught in some higher water layers during the hauling up of the net).

The intermediate volumes of water in the Catalonian Sea come from the northern part of the Balearic Sea. They become thoroughly mixed up by convection currents (salinity as well as temperature are very uniform in the different strata). The Balearic Isles are, towards the west, connected with the east coast of Spain, by a treshold, which must partly be barring the passage of the intermediate water masses, but to what extent? If any considerable volumes of water were forcing their way over the threshold west of the Balearic Isles during the summer, we might expect to find such species as *Rhopalonema velatum* and *Pelagia noctiluca* (abundant at stat. 209, see above) at the stations west and south of Iviza, but, as a matter of fact, no medusæ at all were found in these localities. According to Nielsen (p. 157) "the movement probably continues during the autumn[1] in a south-westerly direction along the Spanish

[1] spacing by me.

coast, which means that new intermediate masses of water are carried down into the Alboran Sea and towards Gibraltar". NIELSEN also states (a few lines further below) "that the whole of the intermediate layer in the northern part (of the Balearic Sea) disappears in the course of the winter as the result of the mixing process following upon the cooling, and that new intermediate masses of water are then added in the course of the summer and autumn".

The explanation of the absence of medusæ west and south of the Balearic Isles in July must be this that the south-going intermediate current had not yet passed the threshold, and the considerable accumulation of medusæ north-west of the islands demonstrates that the intermediate masses of water moving from the north-east into the Catalonian Sea during the summer, come to a temporary stop there, until, towards the autumn the inflow becomes so powerful that some of the water masses are pushed forwards over the threshold.

The movement of the surface water in the Balearic Sea is, mainly, a cyclonic circulation along the borders of the area. In the Catalonian Sea we find this water as a south-going current along the Spanish coast. It was here (at stat. 210) that we found the large number of surface-water medusæ. The complete absence of medusæ at stat. 211, nearer by the coast (depth 150 m), indicates that the south-going movement does not reach quite into the shore. The same explanation may hold good as to stat. 213 (somewhat further south), where likewise no medusæ were found. Neither did the surface water contain any medusæ at the stations west and south of Iviza (stat. 215 and 216). According to NIELSEN the south-going surface-water current leaves the Spanish coast and turns towards the east, moving south of Iviza to join the east-going Atlantic current, which, further to the east, sends a branch towards the north into the northern part of the Balearic Sea. The occurrence of the medusæ, in connection with the distribution of water with comparatively low salinity (as seen from the sections 14, 15, and 16, on plate VII in NIELSEN's paper) seem to me to demonstrate that the inflowing Atlantic water, as soon as it has entered the Balearic Sea, spreads along the surface of the latter in all directions (at least in summer and autumn), though, of course, mainly into the eastern parts of the basin. It also moves northwards along the Spanish coast, where it meets the south-going current so far to the north that the latter is forced into an easterly direction north of Iviza, perhaps even partly to the north of Majorca (obs. the absence of medusæ at stat. 208, north of Majorca). According to this supposition there should exist a special cyclonic circulation of the surface-water within the Catalonian Sea, which might account for the peculiar distribution of the medusæ in this region.

The hydrographical conditions of the Strait of Gibraltar are characterized by a considerable inflow of Atlantic water at the surface and a slightly less considerable outflow of Mediterranean water along the bottom. The inflow as well as the outflow have their maximal intensity towards the end of the summer. In the Strait of Gibraltar the inflowing Atlantic water becomes somewhat mixed up with Mediterranean water; during its further proceeding eastwards along the north coast of Africa it increases very slightly in salinity (hardly more than $^1/_2$ ‰ from the Alboran Sea to the Pantellaria Channel). The outgoing undercurrent in the Strait of Gibraltar consists of water from the intermediate strata of the Alboran Sea. The outflowing water masses rise somewhat towards the surface as they force their way over the threshold at Gibraltar, and then sink towards the deeper layers in the Cadiz Bay. The intermediate water layers of the Alboran Sea are renewed by an inflow from the Balearic Sea, partly east of the Balearic Isles, partly (during the autumn) along the east coast of Spain (see above). The main part of the water comes from the northern part of the Balearic Sea (*i. e.* from a region, where the different water layers are thoroughly mixed up by convection currents). The salinity, therefore, is not very high (about 38.4 ‰), somewhat lower at the northern than at the southern side of the Alboran Sea.

The Alboran Sea was examined by the "Thor" at three different seasons. The most important investigations were made in the section between Cape Gata (Spain) and the coast of Algeria, near Oran (sections 17, 18 and 19 in NIELSEN's paper). The difference in the composition of the medusan fauna at

the three different seasons was very remarkable. In February 1909 (stat. 51—60) only a few specimens of *Pandea conica* were found in the upper strata, and a number of *Periphylla hyacinthina* were caught in a deep-water haul with 2600 m wire out at stat. 53, and in a haul with 300 m wire out at stat. 51. — In June 1910 (stat. 99—110) no less than 13 species occurred in the same area, partly in considerable numbers. — $2^1/_2$ months later (in September, stat. 220—228) this rich fauna had almost entirely disappeared, only a few specimens of *Pandea conica* still occurring in the upper strata.

In order to explain this peculiar reduction of the fauna we may divide the species, found in June 1910, into 3 groups, according to their biological habits. 1) Meroplanctonic, neritic species with a seasonal occurrence, mostly belonging to the upper strata: *Leuckartiara octona*, *Neoturris pileata*, *Laodicea undulata*, and *Mitrocoma cirrata*. The pelagic life of these species only lasts for a comparatively short period, they may, therefore, at once be excluded from the discussion. *Köllikeria fasciculata* may likewise be a seasonal form, but it belongs to the intermediate strata; the stock of this species, found in the Alboran Sea, is undoubtedly of local origin; as pointed out in the special part (p. 4) it follows the outflowing water into the Cadiz Bay. — 2) Bathypelagic forms, the development of which is more or less independent of the seasons: *Tiaranna rotunda*, *Octocanna funeraria*, and *Periphylla hyacinthina*. These species might be expected to occur in the deep-water of the Alboran Sea at every season, and, in fact, *Periphylla hyacinthina*, the more abundant of the three, was found in February. The missing of the two other species in February and September, and of *Periphylla* in September, may, possibly, be due to defiency of investigation; in June three deep-water hauls were made, each of one hour's duration; in September only one haul was made (duration 30 minutes), and in February 1909 one haul ($1^1/_2$ hour) with the 2 m ring-trawl, not with the young-fish trawl. In June *Periphylla* was found abundantly in all of the three deep-water hauls, whereas the two other species were only found at stat. 106; they are, accordingly, less common than *Periphylla*. — 3) Species, which occur in the Mediterranean all the year round, though with a maximum in the summer, and which mainly belong to the upper part of the intermediate water layers or to the surface-water: *Pandea conica*, *Rhopalonema velatum*, and *Liriope eurybia* (probably also *Liriope exigua* and *Liriope mucronata*; these species must, however, be excluded from the discussion, because we know too little about their biology). *Liriope eurybia* is almost exclusively found in the upper water layers; it is rare in the Balearic Sea, but not uncommon in the Atlantic, and it was found by the "Thor" in June 1910 in the Cadiz Bay, and, abundantly, off the west coast of Portugal (stat. 85). The few specimens, found in the Alboran Sea in June, therefore, most probably belong to the Atlantic stock, and have been carried into the Mediterranean by the surface-water current. *Rhopalonema velatum* was very rare in the Alboran Sea, even in June, (only 5 specimens were found at stat. 106, 300 m wire), an important fact, which shall be discussed below. *Pandea conica* was found in the Alboran Sea at every season of the year, though far more abundantly in June than in September and February. The considerable decrease in number from June to September may only partly be explained by the medusa having a maximum of occurrence in the summer time. The biological habits of this species are most peculiar. It has, undoubtedly, a fixed hydroid stage, living at the bottom in deep water; the medusa, when liberated from the hydroid, has a marked tendency to ascend to higher water layers. In the Alboran Sea by far the greatest number of specimens were found in June in hauls with 65 m wire out, thus in the surface-water proper. The medusa was particularly numerous at stat. 107 (in the middle part of the Cape Gata section). In June the eastward movement of the surface-water is not very strong, but towards the autumn, when the intensity of the current increases, the medusæ, which have ascended into the upper layers, are seized by the current and carried eastwards into the Mediterranean.

The scarcity of *Rhopalonema velatum* in the Alboran Sea is very remarkable. It is by far the most numerous medusa in the intermediate waters of the western part of the Mediterranean; in the southern part of the Tyrrhenian Sea and in the central and south-eastern parts of the Balearic Sea there are not rarely found more than 1000 specimens per 1 hour's haul with the young-fish trawl (in June, July,

and August). It is an inhabitant of the intermediate water layers, being the most abundant at a depth of about 200 m below the surface, but also very common in greater depths. We have above discussed the absence of the species west and south of the Balearic Isles in July 1910. But, as the intermediate water-masses of the Alboran Sea are, in fact, renewed by an outflow from the Balearic Sea, it seems peculiar that none or very few specimens of this medusa are carried into the Alboran Sea, not even in September, when the westward movement of the intermediate water layers approaches its maximal intensity. The only explanation seems to me to be that the movement of these water masses is very slow, so that the increasing outflow to the Atlantic at the end of the summer is more due to an increased pressure westwards than to any considerable horizontal displacement of the water masses in the Balearic Sea. We must remember that a slight westward displacement of water into the funnelshaped western part of the Mediterranean will be sufficient to involve a powerful outflow through the narrow Strait of Gibraltar. But when the movement is slow, the deflecting power, caused by the rotation of the earth, is also very slight, so that the undercurrent from the Balearic Sea into the Alboran Sea does not necessarily keep to the right along the southern slope of the plateau, formed by the Balearic Isles, but may as well comprise the water masses along the African coast. In fact, I think that by far the most important movement of the intermediate water layers in the Balearic Sea is the cyclonic circulation in the central part, and further, that the intermediate water layers of the Alboran Sea are in a state of comparative tranquility. This might account for the fact that the Alboran Sea has, so to speak, a medusan fauna of its own, very much resembling that of other parts of the Mediterranean, but with certain peculiarities. A number of species are found partly in the Alboran Sea, partly in very distant parts of the Mediterranean, and the biological habits of certain species (as e. g. *Neoturris pileata*) are different in the Alboran Sea from what they are in other places. It might also account for the complete missing in the Alboran Sea of *Pelagia noctiluca*, a species which is common in most other parts of the Mediterranean, and also in the Atlantic.

Before leaving the Mediterranean and its fauna, I want to say a few words about the occasional ascent of bathypelagic medusæ from the deep strata into higher water layers. Instances of this phenomenon were observed in various localities during the cruises of the "Thor". Convection currents, caused by the cooling of the surface water during the winter, do not seem to play any prominent part in this respect. The phenomenon may occur in regions where (according to Nielsen) the convection currents only comprise the surface layers (e. g. the Tyrrhenian Sea), and it may occur in the summer.

One circumstance is, however, common to nearly all the localities in which an ascent of bathypelagic forms was observed: they are near by land and particularly to be found in places where the bottom slope is steep!

Immediately east of the threshold at Gibraltar (stat. 99, June 24th 1910) two specimens of *Tiaranna rotunda* were taken in a haul with 300 m wire out). This is easily understood; when the intermediate water masses of the Alboran Sea, which are subject to a strong pressure from the east, are forced into the Atlantic, they must rise considerably towards the surface in order to surpass the threshold of the Strait of Gibraltar. It is, no doubt, due to similar hydrographical phenomena that such species as *Tiaranna rotunda* and *Octocanna funeraria* were known from the Strait of Gibraltar in early times (these species were both described by Quoy & Gaimard 1827), when no implements for bathypelagic fishing existed.

In the Ægina Bay (stat. 18, Dec. 30th 1908) the intermediate water masses of the Ægean Sea have carried a well marked bathypelagic form as *Octocanna funeraria* into a shallow-water area (depth at stat. 18: 220 m), where 2 specimens were found in a haul with 300 m wire out. We have already mentioned (p. 57) the accumulation of *Rhopalonema velatum* at stat. 179, just outside the Dardanelles, at a higher level than elsewhere in the Ægean Sea.

At stat. 152, off the north coast of Barka, where the bottom slope is very steep, 5 specimens of *Solmissus albescens* were found in a haul with 300 m wire out in July 1910.

Solmissus albescens was frequently found in comparatively high water layers in January and February 1909, partly in considerable numbers. At stat. 35 (near Monaco, depth more than 2000 m, but very rapidly decreasing towards the shore) 22 specimens of *Solmissus* were found in a haul with 200 m wire out). — At stat. 45 (off the north coast of Tunis, depth more than 2150 m) the species was very numerous in hauls with 300 and 65 m wire out (about 85 and 170 individuals respectively; some specimens of *Periphylla hyacinthina* were also caught in the haul with 300 m wire out). The locality is somewhat distant from the coast of Africa, but immediately west of a shallow bank stretching northwards from the coast of Tunis. As we have seen, the main outflow of intermediate water from the Tyrrhenian Sea into the Balearic Sea keeps to the south coast of Sardinia, thus not reaching the locality of stat. 45. The intermediate water masses of the Balearic Sea tend to continue their westward movement and cause an enormous pressure in the Alboran Sea; but as the narrow Strait of Gibraltar can only receive a very small part of the extensive water masses of the Balearic Sea, the pressure must disperse into other parts of the basin, and may, very likely, be especially powerful in localities like that of stat. 45, where an angle is formed between the coast and the above-mentioned shallow water bank.

In the Tyrrhenian Sea *Solmissus albescens* was found abundantly (about 85 specimens) at stat. 39 near the east coast of Sardinia in fairly deep water (1000 m wire out). But, moreover, a number of specimens were found in higher water layers in the neighbourhood of Naples (stat. 26 and 28, 65—200 m wire out); this is, no doubt, connected with the westward movement of the water in the southern part of the Tyrrhenian Sea, south of a line from Naples to the south point of Sardinia (see p. 60). We also know from the literature (Lobianco) that in the Gulf of Naples several bathypelagic species come to the upper water layers at certain seasons. The specimens of *Periphylla hyacinthina* and *Solmissus albescens* found further west in the Tyrrhenian Sea (stat. 24, in hauls with 25 and 300 m wire out respectively) have, probably, risen towards the surface somewhere in the neighbourhood of the Gulf of Naples and been carried westwards by the current.

We also know from the literature that bathypelagic organisms may occasionally occur in the surface layers in the Strait of Messina.

ATLANTIC.

The collections of medusæ made by the "Thor" in the Atlantic between Ireland and Morocco, are rather few and scattered. I shall, therefore, not enter on a thorough discussion of the results.

In the case of a number of Atlantic deep-sea species the known area of distribution has become very much extended by these collections. *Rhopalonema funerarium* was for the first time found in the northern Atlantic. *Pantachogon rubrum* and *Æginura grimaldii*, both formerly known from the tropical Atlantic, have been found in recent years to occur in the North Atlantic, west of the British Isles, and in the Davis Strait. The "Thor" found these species in the Bay of Biscay, *Æginura grimaldii* even in the Cadiz Bay, so that the known areas of distribution tend to be confluent. — The other deep-sea medusæ, found by the "Thor" were: *Colobonema sericeum*, *Ægina rhodina*, *Atolla bairdii*, and *Periphylla hyacinthina*. — Of all the above-named species *Periphylla* is the only one which also occurs in the Mediterranean. This species is, in fact, not so strictly bound to the deep-water as the others are.

Of the medusæ of the upper strata only *Pelagia noctiluca* was found in considerable numbers. — *Liriope eurybia*, *Rhopalonema velatum*, and *Nausithoë punctata* are widely distributed both in the Atlantic and in the Mediterranean. As mentioned above, the specimens of *Liriope eurybia*, found in the Alboran Sea in June 1910, were undoubtedly carried in from the Atlantic through the Strait of Gibraltar. It is a very interesting fact that the common north-atlantic medusa, *Aglantha digitale*, was found by the "Thor" far more to the south than formerly known; it was even found in the Strait of Gibraltar, but not in the Mediterranean, where, in fact, it was never found.

In the Cadiz Bay and the Strait of Gibraltar the following Mediterranean Hydromedusæ were

found in June 1910: *Köllikeria fasciculata, Pandea conica, Mitrocoma cirrata, Phialidium hemisphæricum,* and *Eirene viridula.*

Köllikeria fasciculata, which belongs to the intermediate strata of the Mediterranean, was found at stat. 89 in a haul with 1000 m wire out, thus in the outflowing Mediterranean water. This is the first record of the species outside the Mediterranean.

The specimens of *Phialidium hemisphæricum* and *Eirene viridula* may be of local origin.

According to NIELSEN (p. 171) "the inflow in the Straits of Gibraltar is dependent on the prevailing winds; .... it becomes reduced with easterly winds, which may even lead to a surface-current flowing out of the Mediterranean. But this is probably of rare occurrence". The occurrence at stat. 95, just outside the Strait of Gibraltar, in June 1910, of *Pandea conica* and *Mitrocoma cirrata* (one specimen of each species, the former never before observed in the northern Atlantic), both of which were, at the same time, abundant in the surface layers of the Alboran Sea, must no doubt be due to such an outflow from the Mediterranean.

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Mediterranean Tintinnidae.

By

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I. INTRODUCTION.

The Tintinnids belong to the most important plankton organisms, most of them being "oceanic" (holoplanktonic), whilst, on the other hand, they also comprise truly "neritic" (meroplanktonic) coast forms, especially the members of the comprehensive genus *Tintinnopsis*.

In plankton samples, however, one has nearly always to deal only with empty loricae, the animalcules leaving them when disturbed, or contracting and soon perishing, if not immediately treated with special fixation fluids. Empty loricae make, on the whole, an essential part of the plankton, apparently even in the sea.

The exact constitution of the animalcules has been little known, almost down to the present time, chiefly on account of their rapid motion and the disturbing effect of the powerful rotating ciliary plates, the membranelles or pectinelles. In later years, however, several zoologists have studied some of these interesting organisms more thoroughly in a living state, so that we now know the main features of their organization as regards several of the commoner species.

The first more exact study of the living animalcules was made by Claparède and Lachmann (1858—59) with material from the Norwegian west coast. Later on Tintinnids were occasionally dealt with by some few authors, among whom Haeckel (1873), Fol (1881, 1884) and Entz (1885, 1886) worked with Mediterranean material. The first author, however, who devoted himself to a special and thorough study of the whole group of species in a living state, was Daday (I887), who gave the first complete monograph, dealing with in all 10 genera and 69 species, of which 3 genera and 29 species were established as new ones. He succeeded in stating the shape of the living animal, its mode of fixation in the lorica, the number of membranelles — which he considered of generic value — and the number of nuclei in a great many species. In later years the difficult study of living Tintinnids has been continued and furthered by Schweyer (1905, 1909) and Merkle (1909), whilst Laackmann (1906) has studied the nuclear phenomena during fission and reproduction and Entz jun. (1909) has made a careful and comprehensive study of stained material in toto and in sections.

In spite of these careful studies by several scientists there are still several very important questions waiting elucidation, as for instance the formation of the lorica. Also, the conclusions arrived at by the different authors are often contradictory.

A new and very important paper on the Tintinnids has just been published (Fauré-Fremiet 1924) which gives new and very interesting details of their organization.

With a view to what is to follow, I give here a brief survey of this organization of the animalcules, according to the experience obtained in the last twenty years.

The shape of the animalcule in a swimming state is usually campanulate or conical, below mostly more or less abruptly narrowing into a pedicle, fixed at the bottom or lateral wall of the lorica, frequently on one side with some myofibrils, passing over into the lower half of the body (fig. I). Sometimes the body is only attenuated below, in other cases divided into 2—4 short pedicles. At the upper

end the body is cut off to a more or less broad peristomial disc, surrounded by a tubular incrassate peristomial collar, carrying on its top a wreath — or rather, ventrorse spiral (ENTZ jun. 1909, SCHWEYER 1909) — of, usually 16—24, powerful, long and narrow triangular, obliquely fixed ciliary plates, the membranelles or pectinelles. The peristomial disk, sunk into the upper end of the body carries the mouth in a more or less deep, eccentric "preoral cavity", where some of the membranelles descend. About in the middle of the disc there is a more or less thick and elevated "piston" which sometimes shows a pumping motion. The membranelles somewhat resemble long and narrow knives with their backs turned outwards, where they are limited by a strong rim; inwards they are more or less deeply fringed into cilia. The peristome collar appears frequently or mostly lobulate, with rounded lobes, the membranelles being inserted lower down and the interstices occupied by more or less elevated plasma bodies running parallel to the insertion-lines of the membranelles (Deckplättchen and Begleitkämme, ENTZ jun.). In these interstices between the bases of membranelles, on the inner side of the peristome collar (SCHWEYER) there are in certain species peculiar stalked, clavate or tentaculiform organelles — in the following for the sake of brevity called tentaculoids — which seem to be very variable in length and shape and therefore perhaps very contractile in the living animal. They were already seen by HAECKEL (1873) and were later observed by SCHWEYER, ENTZ jun. and FAURÉ-FREMIET. We have here perhaps a character which may be useful in systematic respects, together with the shape of the collar. Between this latter and the body there is frequently a more or less marked constriction.

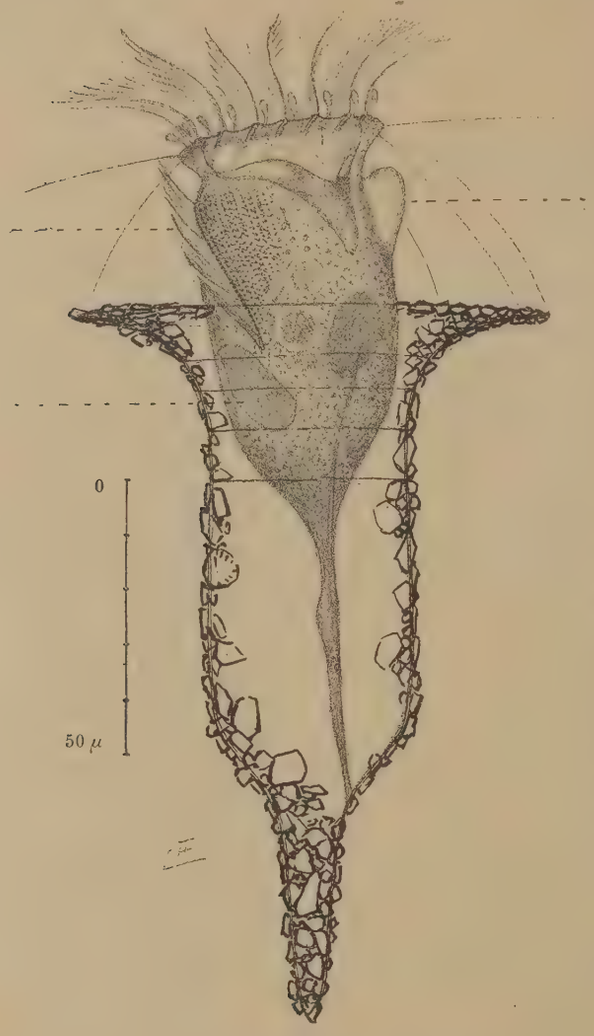


Fig. I. *Tintinnopsis campanula* (Ehrb.) Dad., copy from Fauré-Fremiet 1924.

The number of membranelles has been considered constant for a definite genus; MERKLE (1909) found it, however, considerably varying in the genus *Tintinnopsis*.

Otherwise the body is usually provided with more or less long and distant longitudinal rows of generally short cilia. FAURÉ-FREMIET (1924) found in species of *Tintinnopsis* and in *Stenosemella ventricosa* (l. c. pp. 90—97) also another lateral field of cilia, on one side, below the peristome collar (fig. I), in close series, short, with exception of the limiting series on the right side which consists of coalescent longer ones, making an undulating membrane. He also found in the same species some fine and long, less mobile, but elastic setae, spreading out from the outer side of the peristome collar to the broadest part of the lorica (fig. I), probably acting as a support for the outstretched animalcule.

Most of the marine Tintinnids have proved to possess two large, roundish or ovoid macronuclei, each with a smaller, round, micronucleus. The number of nuclei is, however, very often differently reported by different authors which may in many cases be due to disturbing phenomena of reproduction. In

certain genera, especially in those having a lorica provided with a collar, the number of nuclei seems to be constantly 8 or more, according to Entz jun. (l. c.) even sometimes (in *Petalotricha* and *Codonellopsis orthoceras*) reaching 50—300. Haeckel, however, believed to have seen *Cyttarocylis cassis* and *Tintinnopsis campanula* in a stage of sporulation, and Laackmann (1906) also reports the same phenomenon for the latter species and others. It seems therefore necessary to wait for the results of further investigations in regard to these cases of numerous nuclei, before they are used for establishing special genera or subfamilies.

While hoping for further important reports on the animalcules in a living state, our knowledge in this respect is, however, as yet too inconsiderable to be used as the chief base for a systematic treatise of the whole group, containing now a great many forms, which, judging from their loricae, are, on the one hand very multiform, on the other certainly uniform enough to permit the distinction of very well defined species.

We must still provisionally found the system of Tintinnids on the loricae, utilizing the knowledge obtained as to the organization in the best way possible. Such a system will, of course, be an artificial one, but may be gradually amended, by clearing out the disturbing elements.

The first system, comprising a greater number of species, was that of Daday (1887), which, in my opinion, is still the most practical or useful one, needing, however, certain reservations and developments. It was, in the first hand, based upon the structure of the wall as seen in optical section, especially upon the difference between simple (single) and double walls, with differentiated inner and outer limiting lamellæ. This difference is not sharp enough to afford a completely certain character in all cases; it gives, however, in well developed loricae often or mostly an excellent distinguishing mark which, in any case, should not be ignored.

After Daday, the most comprehensive work on Tintinnids was published by Brandt (1906/7), properly consisting of two or three separate works, the pictorial work (1906) by Glockentöger and the treatise by Brandt (1907), based to a great extent on these figures and also containing the result of countings on board the Humboldt Plankton Expedition. The huge material of this expedition seems only partly to have been examined by Brandt himself, apparently often by means of slides (containing selected individuals?); he has also utilized other materials. His system is primarily based on the mostly very fine and inconspicuous "primary" Waben-structure, detected by Biedermann (1892) and later, by Brandt, stated for all (or nearly all) genera of Tintinnids. This "primary" structure was used by Brandt, in connection with a similar, much coarser "secondary" structure — this term only applicable when a double structure is present — and even sometimes a "tertiary" one (in *Codonella* and *Tintinnopsis*). This "primary" structure seems, however, to be a general feature among the Tintinnids, therefore giving no good distinguishing characters, except when strikingly coarser than usual, or uneven, or, at all extraordinary in some way or other. Brandt ignored some other, more easily applicable, characters, for the sake of consistency, as for instance the normal posterior aperture in *Tintinnus lusus-undæ* etc., the "double" wall in most cases, in contradistinction to "single", and therefore withdrew some of Daday's genera, restoring the species to the old genus *Tintinnus*. On the other hand, he found considerable difficulty in limiting some of his newly established genera or subgenera, as is plainly seen from the vacillating denominations of species within the genus *Cyttarocylis* and its subgenera. This difficulty is a very natural one.

Brandt left the genus *Tintinnus* in a very complicated state, consisting of very different members; this is also the case with his genera *Ptychocylis* and *Cyttarocylis*. In the latter, however, he introduced several subgenera, partly very natural ones, partly making the border line towards the genus *Undella* very uncertain and unnatural. This inconvenience is with Brandt and other German authors on Tintinnids in part counterbalanced by introducing special groups of species, their so-called Formenkreise, which in complicated cases — e. g. in the genera *Tintinnus* Bdt. and *Ptychocylis* Bdt. — are of great use.

As regards the Mediterranean our knowledge of its Tintinnids before the cruises of the "Thor" was chiefly due to Daday (1887), before him in some degree to Haeckel, Fol, Entz sen. and Gruber, later to Cleve, Lohmann, Brandt, Entz jun. and Laackmann, occasionally also others.

In dealing with the great material of the "Thor" I have considered it necessary to try to make the system based on the loricae as natural as possible, in accordance with our present knowledge of the animalcules on the one hand, and with the supposed relationship, as judged from our extended knowledge of the loricae, on the other hand. In this connection it is very unfortunate that we are still almost wholly unacquainted with the way in which the loricae of the marine species are built up. ENTZ sen. (1885 p. 195) describes this process for the fresh-water species *Tintinnidium fluviatile*: secretion of a jellied substance, at first glutinous, then firmer, surrounding the animal in all directions save above; these young, thimble-shaped loricae then grow, according to ENTZ very probably by repeated secretion of "annuli or tubular segments" at the mouth, though no trace of annulated zones of growth is to be found on the finished lorica. Much later SCHWEYER (1905, 1909 p. 143) found that *Tintinnus inquilinus* and *Cyttarocylis* (*Favella*) *ehrenbergi* secretes an annulus of a similar structure to their loricae, (without a structure in the first species, with an alveolated "Waben"-structure in the other), the secretion taking place exteriorly from a constriction below the peristome collar of the former animal in fission-stages. SCHWEYER is of the opinion that this process is the beginning of the formation of lorica.

Provisionally it must be considered doubtful whether the loricae are built in this way, though some other experiences (of mine) point to the same conclusion; it seems, however, very probable that the growth in length takes place in a similar way. This is probably also the mode of formation of the peculiar loricae occasionally met with, in which the upper part of another lorica protrudes from their mouth (fig. 79 p. 67; see also e. g. LAACKMANN 1906, pl. I fig. 14). Perhaps also the tubular loricae open below, e. g. in *Tintinnus lusus-undae*, are (wholly) built in this way, it should, however, a priori, seem most probable that the ordinary loricae, without posterior aperture, are formed in this posterior portion in a similar way to that described by ENTZ for *Tintinnidium*. ENTZ jun. (1909) considers the special closing apparatus found in *Codonella* and allied genera to be formed — as well as the lorica itself — by some sort of "Häutung"; he is, however, otherwise of the opinion that the lorica in different genera is formed in different ways, also partly as SCHWEYER suggests, and that the "annuli" gradually conglutinate, the limiting lines disappearing.

To obtain more "natural" genera I have thought it necessary to propose several new names, to be used for new genera or subgenera. I will here give a brief survey of these new names and at the same time of the most important differences and connections between the generic groups.

The simplest wall of lorica is a thin membrane, apparently destitute of structure, as in *Tintinnus lusus-undae*. A further developed stage shows a finely reticulated wall, the "primary" "Waben"-structure (BRANDT). In a certain sense this wall is already a "double" one, showing a (single) layer of "primatic elements" (KOFOID) between the outer and inner side of the wall. A further development shows thickened outer and inner sides, two lamellae, with one, or perhaps two or more, layers of primatic elements between, the two lamellae being connected by thinner walls.

Such is the structure in the genus *Cyttarocylis*, only with the difference that the prismatic elements between the lamellae are "secondary" ones, showing also a much finer "primary" reticulation. BRANDT seems always to presume that this primary reticulation is due to much the same elements as the secondary, and that these finer prismatic elements both constitute the walls of the secondary ones and fill up their lumina. This is a difficult question which cannot be decided by GLOCKENTÖGER's figures; a priori one should, however, think that there might be some difference in this respect between the lamellae and their interstices.

When young or thin, the wall with a single layer of small prismatic elements may appear single, though in a more developed state it proves to be obviously double. This seems to be the case for instance with some forms of *Favella azorica* from the Mediterranean. An apparently single wall is therefore no infallible mark of distinction, at any rate in reticulated species.

In the genus *Undella* it is quite different. Here there are two thick and well defined lamellae,

separated by an apparently structureless interstice. This latter seems in many cases to possess a reticulation, whilst this mostly is more or less coarse and conspicuous in the lamellae. Here is just a case in which one should think there might be a considerable difference in structure between the lamellae and their interstice.

Closely allied to the genus *Undella*, with the characteristic double wall as set forth above, is, on the one hand, the genus *Xystonellopsis* n. gen., one of the "Lanzentintinnen" (Biedermann, Brandt), on the other hand the genus *Epiplocylis* n. gen., comprising *Ptychocylis undella* (Ostf. et Schm.) Bdt. and its near allies. In both genera the two lamellae of *Undella* are very well defined and conspicuous. *Xystonellopsis* is in part very similar to the genus *Xystonella* (Bdt.) Laackmann, but different from that genus in having the same thin-walled mouth as in (most species of) *Undella*, not the broad, channelled (double-rimmed) one, as in *Rhabdonella* and *Xystonella* (here below). In *Epiplocylis*, the same two conspicuous lamellae as in *Undella* are seen in the upper half of the lorica, in the lower, however, the outer lamella shows a coarse reticulation of excavated meshes, at the bottom of which it is nearly clapped down upon the inner lamella.

The old-established genus *Cyttarocylis* was already limited by Laackmann (1911) to comprise only the two species *C. cassis* and *C. eucecryphalus* (*C. plagiostoma*). It belongs to a natural series of genera, in which the lorica in its uppermost part is provided with a "collar", more or less distinctly set off from the "body" by an inward protruding edge. In this series we find the well-established genera *Dictyocysta* and *Petalotricha*; as regards the genus *Codonella*, I have removed from it a series of species with an "annulated" collar — *C. orthoceras* etc. — under the newly proposed name of *Codonellopsis*. For the rest of the earlier genus *Cyttarocylis*, after further removing of *Coxliella* and *Xystonella* (with *Xystonellopsis*), I have proposed the name *Favella*. A transition to the single-walled genera is formed by *Undella azorica* Cl. (or properly by some of its forms) wich I have provisionally listed as a species of *Favella*, by the isolated *Tintinnus subulatus* Ehrb., for which I have proposed the new name *Helicostomella*, also including some other species with a lorica "annulated" above (but without a collar), as well as by *Amphorella mediterranea*, another isolated species, for which I have proposed a provisional new name, *Metacylis*. Perhaps both this latter species and the above mentioned *Favella azorica*, or those "forms" of it, may be included in the proposed genus *Helicostomella*. Further I may mention that the singular species *Coxliella scalaria* has provisionally been placed in a separate genus, *Climacocylis*.

Among the loricae with a simple (single) wall it will be natural to include *Tintinnus lusus-undae* and the similar, closely allied tubular loricae in a special genus *Tintinnus* Schrank, Daday, a generic group, also well defined on account of the organization of the animalcules. *Tintinnus acuminatus* and similar forms also possess a normal posterior aperture, but their loricae differ essentially in shape and development; I have therefore placed them in a special genus, for which I have proposed the name *Salpingella*. Brandt and, after him, Laackmann seem to lay no special weight on this normal posterior aperture, obviously because of different other species, *Tintinnopsis* "*aperta*" and *T.* "*fracta*" (see below under *T. radix*) as well as *Rhabdonella spiralis* and sometimes *Cyttarocylis cassis* (see fig. 90 p. 78) being occasionally found with a fine or irregular aperture at the end of the taillike prolongation of the lorica.

The most primitive types of loricae are found in the genera *Tintinnus*, as defined above, and *Amphorella*. This latter genus still remains a rather artificial one, including many, as yet little known, species of small size, as well as forms differentiated in different directions. It contains, perhaps, the most ancient forms, connecting different genera, f. i. *Amphorella* simplex Cl., a form, transitional to the characteristic and easily distinguished genus *Rhabdonella*. This genus is nearly allied to the genus *Xystonella*, but differs in having many longitudinal, slightly elevated plicae on the outer lamella. The wall is obviously double towards the channelled mouth, less distinctly so below. *Amphorella simplex* is, however, single-walled and has only few striae or low plicae, and there is no channelled mouth. For this species and a nearly related one, more similar to a small species of *Rhabdonella*, I have proposed the new genus

Protorhabdonella. In this connection it is of interest to find, also in the genus *Amphorella*, a transition to the channelled mouth of *Rhabdonella* (see *Amphorella torulata* and *A. oxyura*, figs. 23, 24).

The genus *Tintinnopsis* seems to contain at least two different genera or series of species, one around the higher developed *T. campanula*, with tentaculoids and an "annulated" lorica, another comprising more simple forms, without "annuli" (i. e. helicoidal spiral). A few words may here be added in regard to these "annuli" which — when distinctly visible near the oral aperture — have always proved to be no true rings, but parts of a single helicoidal band. BRANDT speaks, in this connection, of a "Spiralleiste" between both lamellae, often calling it a "Verstärkungsleiste". Though this "Leiste" properly speaking is only formed by the — frequently somewhat protruding — upper sides of the different turns of the spirally twisted band, BRANDT is certainly right in assuming that it is just this intermediate firmer layer which gives the band its value as a support. The close-set lamellae at the mouth of loricae in *Undella* and *Xystonellopsis*, and at the bottom of the meshes in *Epiplocylis* probably act in the same way; they will prevent a displacement. It may therefore be expected that, in cases where the growth in length takes place more rapidly and continually, or a special supporting of the wall is not needed, the limiting lines between the successive turns may soon become indistinct or disappear. If this is correct, there may be no essential difference between the "annulated" and the not "annulated" loricae — or parts of loricae — in regard to their formation.

For the species *Tintinnopsis ventricosa* and *T. nucula*, which have firmer loricae and a narrow, thin-walled collar round the constricted mouth, I have proposed the new generic name *Stenosemella*. FAURÉ-FREMIET (1924 p. 96) describes and figures the animalcule, which seems sufficiently different from those of the commoner species of *Tintinnopsis* to justify the separation.

KEY TO THE GENERA.

A. Lorica not "annulated" (save in *Favella ehrenbergi var.* and *F. azorica var.*).
  I. Wall single (simple) or not with distinct and well separated limiting lamellae.
    a. Lorica always open below (posteriorly), without caudal prolongation.
      1. tubular, everywhere thin-walled ..... *Tintinnus.*
      2. trumpet-shaped, at the dilation above more or less thick-walled ..... *Salpingella.*
    b. Lorica not open below, or occasionally with a small opening at the end of a caudal prolongation,
      1. with agglutinated "foreign bodies" ..... *Tintinnopsis,*
      2. without — — — ..... *Amphorella, Protorhabdonella.*
  II. Wall double, with two well defined and separated lamellae.
    a. Lorica with two collars, the upper dilated above ..... *Petalotricha.*
    b. — — only one collar, or, when two, the upper narrowed above.
      1. Collar with 5 to 20 large "windows" ..... *Dictyocysta.*
      2. — without large windows.
        α. Lorica with a reticulated structure, without "foreign bodies" ..... *Cyttarocylis.*
        β. Lorica with a different structure, usually or frequently with agglutinated bodies.
          * Collar very low, rather inconspicuous ..... *Stenosemella.*
          ** Collar large and conspicuous ..... *Codonella.*
    c. Lorica without a collar.
      1. Lamellae and their interstice without structure, or only with a fine "primary" one.
        α. Caudal prolongation with a lance-socket ..... *Xystonellopsis.*
        β. No lance-socket ..... *Undella.*

2. Outer lamella all over with more or less anastomosing, longitudinal plicae (ribs); mouth channelled ..... *Rhabdonella.*
3. Outer lamella below coarsely reticulated, above as in 1.; mouth not channelled.. *Epiplocylis.*
4. Outer lamella with a more or less coarse, "secondary" structure; no longitudinal plicae, at any rate in the upper half of lorica.
   α. Mouth of lorica channelled (double-rimmed) ..... *Xystonella.*
   β. — - — simple, not channelled ..... *Favella, Poroecus.*

B. Lorica "annulated" (i. e., with a helicoidal band), at any rate towards the mouth.

I. Wall simple (single) or without distinct or well separated lamellae, with a fine or indistinct structure.

a. Lorica without "foreign bodies", diaphanous,

1. "annulated" only in the upper half or towards the mouth.
   α. No collar ..... *Helicostomella.*
   β. A low, "annulated" collar, rarely simple ..... *Metacylis.*
2. "annulated" all over (formed by a single helicoidal band) .... *Protocochliella* (see *Coxliella*).

b. Lorica with agglutinated "foreign bodies" ..... *Tintinnopsis.*

II. Wall with two distinct and well separated lamellae, with a more or less coarse "secondary" structure or with "foreign bodies".

a. Lorica with an "annulated" collar, but not "annulated" "body" ..... *Codonellopsis.*

b. Lorica without a collar, "annulated" all over, with a "secondary", almost regular structure.

1. Lorica only open above; no coarse helicoidal rib on its outer side ..... *Coxliella.*
2. Lorica frequently also open below, with a large helicoidal rib outside ..... *Climacocylis.*

II. THE SPECIES FOUND IN THE MATERIAL OF THE "THOR".

TINTINNUS Schrank.

Loricae plainly tubular, wall thin, simple, without visible structure or only with very fine "primary" reticulation. Animalcule fixed by a (simple or branched) thin pedicle to the lateral wall of the lorica; when disturbed, it leaves its house through the posterior aperture. Adoral membranelles 18 (Daday, Fauré-Fremiet); normally 4 macro- and 2 micronuclei present (Daday, Entz jun., Brandt, Fauré-Fremiet). Peristome-collar with more or less long-peduncled tentaculoids and rounded lobes, alternating with the membranelles (Schweyer, Fauré-Fremiet).

1. TINTINNUS LUSUS-UNDAE Entz (Figs. 1—4).

Entz (sen.) 1885 p. 202, pl. 14, fig. 12.

This species and the following, *T. fraknóii,* are nearly allied and so closely connected by intermediate forms, that it is very difficult to draw any line of separation between them. The present species being, however, the first established, it seems to me most correct to include in it all the forms which

seem to be naturally and closely allied to it, even if they are in certain respects similar to those of the following species.

According to the figure and description in ENTZ, the form which should be considered the main species (fig. 1) is a large one, somewhat resembling the following species. It is tubular and nearly cylindrical, slightly increasing in diameter towards the upper end, here, however, by evenly arched outlines dilated to an obliquely spreading orificial border. Wall throughout simple and devoid of structure, or with scarcely discernible "primary" reticulation.

Length 210 μ—230 μ, oral diameter 51 μ—55 μ, aboral diameter 30 μ—31 μ. A longer form (forma *longa*) is considerably lengthened, 246 μ—280 μ, with an oral diameter of 49 μ—57 μ, and an aboral diameter 32 μ—34 μ. It is all together a characteristic feature of the present and the following species, as also of the species of the next following genus, that the length of lorica is considerably varying, while the diameter and the shape keep much more uniform.

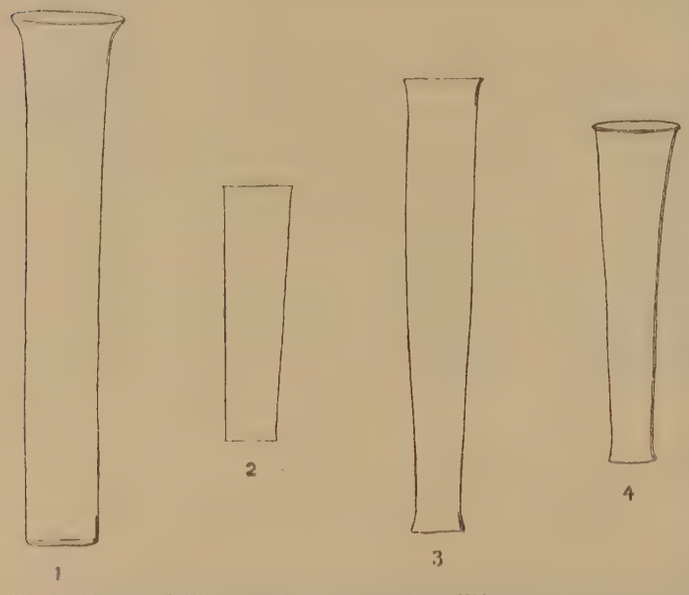


Fig. 1. (*Lorica* of) *Tintinnus lusus-undae* Entz; $^{350}/_{1}$. St. 16. In this and many of the following figures the optical section is shown at the right side only, in others at both sides or at the left. Fig. 2. *Tintinnus lusus-undae* Entz., *var. tubulosus* (Ostf.); $^{350}/_{1}$. St. 79. Fig. 3. *Tintinnus lusus-undae* Entz., *var. elegans* n. var.; $^{350}/_{1}$. St. 28. Fig. 4. *Tintinnus lusus-undae* Entz., *var. macilentus* n. var.; $^{350}/_{1}$. St. 182, 545 m wire.

Port Alice, 12, 14, 15, 16, 18, 20, 23, 25, 26, 28, 29, 31, 33, 36, 38, 40, 42, 46, 55; 126 (0 m., 200 m.—100 m., 500—120 m., 275 m. wire), 152 (950 m. wire), 156 (250 m. wire, 950 m. wire), 158, 160 (0 m., 100 m.—30 m.), 161, 163 (0 m., 80 m.—0), 170 (20 m.—0, 80 m.—20, 1000 m.—195), 174, 175 (30 m. wire, 350 m. wire, 1150 m. wire,), 181, 182 (0 m., 545 m. wire), 183, 184 (0 m., 945 m. wire), 185, 186 (245 m. wire, 1145 m. wire, in salpæ), 187 (945 m. wire), 192 (545 m. wire), 194 (0 m., 1145 m. wire), 196, 197, 198, 199 (0 m., 30 m.—0, 200 m.—80, 945 m. wire), 200, 202, 204, 206 (1945 m. wire), 209 (80 m.—33, 200 m.—85, 1945 m. wire), 210, 213, 218, 221, 223 (1945 m. wire), Gibraltar. Never numerous and very often but singly.

This species was discovered by ENTZ at Naples. Otherwise it is widely distributed in the Atlantic, from 41° S (6° E), trough the warmer regions to the northern part of the Florida Current, but in the colder northern waters seems to be replaced by the following variety. Also widely distributed in the Indian Ocean; in the Pacific it was taken at New Pomerania (BRANDT 1907).

Var. **tubulosus** (Ostf.) (Fig. 2).

Tintinnus tubulosus Ostenfeld 1899 a, p. 63, 1899 b, p. 439 fig. f (p. 437). *Tintinnus lusus undae* Daday 1887 pl. 18, figs. 3, 14.

Lorica quite evenly and slightly narrowing from the mouth to the posterior end, with (almost) perfectly straight lateral outlines. At the oral aperture a more or less distinct, narrow, almost divaricated border. Considerably smaller than the main species, length 94 μ—150 μ, diameter of mouth 32 μ—44 μ, of the posterior end 21 μ—36 μ.

This smaller form is less frequent in the Mediterranean. I have only noted it for sts. 14, 25; 79, 80, 91, i. e. for two stations (in the Adriatic and off Naples) in winter, besides for the Bays of Cadiz and Biscay in June. In our northern waters it is the most frequent form, usually the only form present, very rare on the west coast of Norway and in Skagerrack, in the open sea to 63° N.

Var. **elegans** n. var. (Fig. 3).

Sts. 25, 28, 29, 31, 33, 36, 38, 42; 91, 126 (275 m. wire), 182 (545 m. wire), 184 (945 m. wire), 186 (in Salpae), 199 (200 m.—80 m.), 206 (0 m., 1945 m. wire).

Lorica towards the mouth dilated — as in the main species — with arched outlines, with an obliquely or transversely outwards directed orificial border or rim, then of equal breadth to the middle or somewhat farther, and then again narrowing towards an unwidened or rapidly somewhat widened posterior end.

Length 147 μ—190 μ, diameter of mouth 37 μ—53 μ, diameter of the aboral end 20 μ—34 μ.

This beautiful form is somehow intermediate between smaller forms of the main species and the following variety. It varies considerably in length and width.

Var. **macilentus** n. var. (Fig. 4).

Tintinnus lusus undae var. c and *T. fraknoi var. c.* Brandt 1906—1907 pl. 65, figs. 12, 16, 19, 20. *T. emarginatus var. b.* Brandt 1906 pl. 65, fig. 15.

Lorica above more or less evenly and conically dilated by almost straight laterally outlines and usually spreading (narrow) orificial border, then considerably narrowing, in the lower half frequently of almost equal breadth to the very end, or here again somewhat wider.

Length 142 μ—290 μ, diameter of mouth 39 μ—54 μ, diameter of the aboral end 23 μ—26 μ.

Brandt's two forms, which are somewhat similar to the preceding variety, but of a less regular shape (and beautiful appearance) seem to me naturally to belong to the older and smaller species. Brandt (l. c.) refers them partly to the present and partly to the following species, making a slight dilation of the posterior end the deciding character for *T. fraknóii.*

This last mentioned variety, which I have only noted from st. 182, 545 m. wire, where it occurred together with the preceding variety, I have also seen from Tortugas. Brandt figures it from the Atlantic, south of the Cape Verde Islands, from New Zealand and from New Pomerania.

2. TINTINNUS FRAKNÓII Dad. (Figs. 5, 6).

Daday 1887 p. 528, pl. 18 fig. 1.

Lorica much larger than in the preceding species, towards the mouth more slowly and conically dilated, usually with a narrow, but distinctly visible and spreading rim at the mouth. Downwards the lorica is slowly narrowing, but towards the aboral end again more rapidly and distinctly dilated.

Length 348 μ—493 μ, diameter of mouth 62 μ—68 μ, of aboral end 35 μ—42 μ. The particular long forms are not correspondingly broader at the ends, and may be designated by a special name, *f. elongata* (fig. 5 b).

A shorter and broader form is

Var. **latus** n. var. (Fig. 6).

The smallest diameter of the lorica is situated farther from the aboral end, and the lorica is more gradually dilated below.

Length 353 μ—404 μ, diameter of mouth 74 μ—79 μ, of aboral end 51 μ—57 μ, minimum diameter 38 μ—47 μ.

This is a common warm-water species which was taken at nearly all stations in the Mediterranean, in winter from the innermost stations to Bay of Cadiz, in summer from the north-western coast of Portugal (st. 81, 100 m. wire) to the Sea of Marmora, in the surface as well as below. It was generally present in rather small numbers, especially in winter, when it only occurred at st. 16 (Eastern Mediterranean) in

somewhat greater numbers. In the Bay of Cadiz in February it was only present in small numbers at st. 68, being absent in the Atlantic Current, save at st. 53, but appearing again near the south coast of Spain. During the summer cruise it was taken abundantly at sts. 87, 89 on the south-west coast of Portugal — being there the predominating species (of Tintinnids) — as well as in the Bay of Cadiz, also there the predominant species at sts. 94, 95 and 98, close to the Straits of Gibraltar, in June. The transference to the Mediterranean waters seems at this time fatal or difficult, the species immediately becoming very scarce and often lacking along the African coast. From st. 112 forwards, it is, however, present nearly everywhere, generally sparsely, sometimes (at st. 131) in great numbers. During the return voyage it was again very scarce near to the Straits, being, however, present at both stations in the Bay of Cadiz — here, at st. 231, more numerous at deeper levels — and following up to st. 237, off the north-west coast of Portugal.

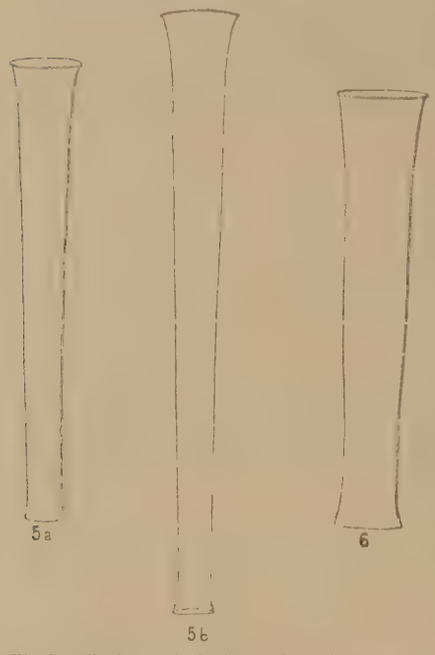


Fig. 5a. *Tintinnus fraknóii*, Dad., main species; $^{175}/_{1}$. St. 152, 950 m. wire. Fig. 5b. *Tintinnus fraknóii* Dad., *f. elongata* n. f.; $^{175}/_{1}$. St. 152, 250 m. w. Fig. 6. *Tintinnus fraknóii* Dad., *var. latus* n. var.; $^{175}/_{1}$. St. 152, 950 m. wire.

Is certainly indigeneous in the Mediterranean; an immigration into the Mediterranean through the Straits could be traced, but was apparently of no greater significance. It seems to multiply in a noticeable degree at times, but the material shows no proper swelling up in numbers save in Bay of Cadiz.

Was in the first instance detected in the Mediterranean by Daday, and later recorded from that sea by many authors. In the Atlantic it is common throughout the warmer regions, from 29° S to 33° N in the Florida Current and probably farther north. It is also widely distributed in the Indian Ocean and in the Pacific.

3. TINTINNUS INQUILINUS (O. F. Müll.) Schrank (Fig. 7).

Trichoda inquilina O. F. Müll. 1786 (p. p.?). Tintinnus inquilinus Daday p. 528, pl. 18 fig. 2; Brandt 1906/7 pl. 65 fig. 14 ("T. lusus undae var. *a* tubulosa").

Lorica — in the two specimens which I saw in the material of the "Thor" — slowly narrowing from the mouth to near the aboral end, where it is rapidly constricted to a short tubular portion, only half as wide as before.

Length 89 μ—94 μ, diameter of mouth 36 μ—40 μ, of aboral end 19 μ—21 μ.

I saw it only from st. 28 and from Salpae, taken at st. 186.

This species, which I have not met with otherwise, is presumably a neritic one; it is reported to occur frequently fixed between the setae of *Chaetoceros*. According to Pavillard (1916 p. 44) this may also be the case with *Tintinnus lusus undae*, which is also stated sometimes to occur fixed to *Hemiaulus*.

Fig. 7. *Tintinnus inquilinus* (O. F. Müll.) Schrank; $^{350}/_{1}$. a in Salpæ, st. 186. b st. 28.

Tintinnus emarginatus Bdt., *T. angustatus* Dad., *T. datura* Bdt.

These three species are also recorded from the Mediterranean, the first and the last mentioned as taken by Lohmann at Messina (Brandt 1907), the second described by Daday (1887) as a new species from Naples. I have seen none of them, but should be inclined to believe that the first one, only differing from *T. fraknóii* in the possession of longitudinal plicae and irregular oral and aboral apertures, might only be an artificial form of the latter species, produced by shrinkage in certain mounting or preserving substances (see *T. undatus*, under *Salpingella acuminata* p. 14). The second, *T. angustatus*, seems only to be a form of *T. inquilinus*, the third, however, *T. datura*, looks

more like a well distinguished species, different from *T. fraknóii* in having considerably elevated longitudinal plicae, remarkably large oral but small aboral, aperture and two macronuclei (?; Laackmann 1911 p. 484 finds 4 or 3).

SALPINGELLA n. gen.

Lorica dilated above to a more or less trumpet-shaped anterior portion, then more or less long tubular, below plicate and narrowing to an open aboral end of very small diameter. Wall of lorica as in *Tintinnus*, but generally more or less thickened at the dilated mouth, here showing more or less developed or thickened limiting lamellae.

The animalcule has two macro- and two micronuclei.

1. SALPINGELLA ACUMINATA (Clap. et Lachm.) (Figs. 8, 9).

Claparède et Lachmann 1858 p. 199, pl. 8 fig. 5. Tintinnus Möbii Brandt 1896 p. 50; T. secatus Brandt l. c. p. 51, pl. 3 fig. 12, Brandt 1906 pl. 67, figs. 2—6, 10, 11; T. acuminatoides Laackmann 1911 p. 480, pl. I. fig. 6.

Sts. 11, 14, 16, 18, 23, 24, 25, 26, 27, 28, 29, 31, 33, 35, 38, 40, 45, 55, 68; 80, 81, 92, 126 (275 m. wire), 129 (600 m.—0, 1100 m.—0), 134 (75 m.—0, 125 m.—75, 200 m.—125), 152 (950 m. wire), 156 (250 m. wire), 170 (80 m.—20, 200 m.—85), 175 (350 m. wire, 1150 m. wire), 182 (545 m. wire), 184 (945 m. wire), 186 (245 m. wire and in salpæ), 187 (945 m. wire), 189 (945 m. wire), 194 (0 m., 1145 m. wire), 199 (200 m.—80, 945 m. wire), 209 (80 m.—33, 200 m.—85, 1000 m.—200), 218, 220, 234 (25 m.—0, 200 m.—95, 700 m.—200).

This rather common and widely distributed species is very varying. The lorica was at first figured with an acute and closed posterior end (Claparède et Lachmann l. c., Entz sen. 1885 pl. 14 fig. 13), which is easily comprehended, this posterior end being pallid and inconspicuous, especially in certain mounting substances. This caused the establishing of the new name *T. Möbii*; a form with a closed end was never found. The lorica, however, varies considerably in length, in the development of the anterior dilated portion and in the degree of thickening there, in the diameter of lorica, in the length of the posterior, plicate portion, as well as in number and length of the plicae. These variations may occur in allied forms from the same locality; there are, however, also considerable differences between forms from warmer and forms from colder regions. On account of these great variations, in the northern waters as well as in the Mediterranean, I have thought it most convenient to try to gather the more important forms under a common name; the distinction of species being otherwise more or less arbitrary and vague.

In this comprehensive sense the species is spread almost over the whole Atlantic, from about 18° S (German South-Pole Exp. $^{26}/_{8}$ 1903) to 80° N (13° E). It is also known from the Indian Ocean, from its antarctic regions (German South-Pole Exp., Gauss-st.), as well as from its tropical area (Cleve 1901 d, Brandt 1907). Also taken in the Pacific on the coasts of Japan (Okamura 1907).

The main species (Claparède et Lachmann l. c., see Jörgensen 1899 p. 8, pl. I fig. 1, and Brandt 1907 p. 388, p. 66 fig. 3) which is common in the northern temperate regions of the Atlantic, though generally scarce, seems not to occur in the Mediterranean or only exceptionally and in doubtful forms. In the material of the "Thor" I have only from one or two stations (134, 200 m.—125 m.; 152, 950 m. wire) and singly seen a form which I might refer with some doubt to the main species. When Brandt (l. c. p. 389) reports this form from many localities in the warmer regions of the Atlantic (Sargasso Sea and North Equatorial Current) this is certainly caused by a different definition of the main species in regard to the following subspecies. This may also be seen from the dimensions quoted by Brandt; he states the length of lorica in the main species to be 200 μ—370 μ, whereas I myself rarely found as much as 300 μ, exceptionally 310 μ.

Subsp. **glockentögeri** Brandt (1907 p. 390, as var., pl. 67 figs. 7, 8, pl. 68 figs. 1—5).

Lorica of greater length than in the main species (252 μ—433 μ, usually over 300 μ) diameter of mouth less great, border markedly spreading or mostly recurved, wall (above) usually less or faintly thickened. Younger(?) loricae apparently have a less broad and less spreading rim of mouth and faint, if any, thickening of wall.

The whole material of the "Thor", only the couple of individuals above mentioned excepted, belongs to this suspecies. There are, however, two forms, or series of forms, which are as a rule fairly easily distinguishable. One of them answers to the first figure in Brandt, quoted above, pl. 67 fig. 7 = pl. 68 fig. 5; it may therefore be considered the type of the subspecies. The other is

Fig. 8. *Salpingella acuminata* (Clap. et Lachm.), subsp. *glockentögeri* Bdt.; $^{350}/_{1}$. St. 28. Fig. 9. *Salpingella acuminata* (Clap. et Lachm.), (subsp. *glockentögeri* Bdt.) *var. attenuata* n. var.; $^{350}/_{1}$. St. 28. Fig. 10. *Salpingella decurtata* n. sp.; $^{350}/_{1}$. St. 26.

Var. **attenuata** n. var. (Fig. 9).

Differs from the type of the subspecies in having almost straight plicae, extending farther upwards and giving the lorica the appearance of being very gradually narrowed towards the aboral aperture. The oral rim is also usually or very frequently only spreading (divaricate or slightly upwards directed, almost as in the northern main species), not reflexed. Sometimes the upper half of the lorica is slightly wider than the lower. The plicate part below nearly always makes more than $^{1}/_{3}$ of total length, while in the typical form of the subspecies, var. *glockentögeri* s. str., it is shorter, usually less than $^{1}/_{4}$.

Length 255 μ—433 μ, diameter of mouth 30 μ—42 μ, diameter of lorica in the middle 14 μ—25 μ, number of plicae 5 or 6, the exact number being sómewhat uncertain.

This variety, which is the most frequent Mediterranean form of the present species, answers very well to the figure 2, pl. 68 in Brandt (l. c.), from New Pomerania, and to figs. 3, 4, from Messina. It is considerably varying in the respects mentioned above, and may scarcely be considered quite distinct from the preceding form; it is, however, nearly always easily distinguished. *Tintinnus acuminatoides* Laackm. (l. c.) answers in part to certain forms of the present variety, f. i. his fig. 7 on pl. L, *var. secata* Laackm., with a very short tubular antapex; this "species", however, scarcely possesses any other distinguishing character in comparison with his other species, *Tintinnus acuminatus* and *T. glockentögeri*, than the narrow, frequently more or less upwards directed rim of mouth, a variation also occurring in the other forms and very probably connected with the less pronounced thickening of wall. If such a form, narrower and with a more upward directed rim, should prove to be not only an accidental one it might be referred to as var. *acuminatoides*.

The animalcule of var. *attenuata*, as well as of the other forms of the present species, has 2 roundish makronuclei and presumably 2 micronuclei.

Occasionally and singly a striking form of this species, f. *undata* Jörgensen (1900 p. 95 as var.), is met with. I cannot follow Brandt (l. c. p. 391, pl. 67 figs. 2—6, 10, 11), in considering this form a separate species; on the contrary, I have got the impression that it is only an accidental form, probably or partly an artificial one, caused by the collapsing of the stiffly expanded orificial rim (by certain preserving or mounting fluids or less effective thickening). It is suggestive in this connection that this form, with an irregularly plicate or apparently coarsely dentate orificial rim, of a smaller diameter than usual,

is met with in the northern form, as well as in the subspecies *glockentögeri* and its 2 (or 3) forms (see also Laackmann l. c. pl. L fig. 5).

From the winter material of the "Thor" the present species proved to be spread throughout the explored regions of the Mediterranean, occurring in all at 18 of the 37 stations, most frequently in the Tyrrhenian Sea — where only absent at two stations — very rare farther west. It was generally very scarce, or found singly, at st. 26 present in somewhat greater numbers, optimum at st. 26 (var. *attenuata*). In summer it showed a similar distribution throughout the Mediterranean as far as into the Sea of Marmora (in deep layers); everywhere, however, only in deeper — mostly very deep — layers, save at two western stations on the coast of Africa, in September. A considerable immigration into the Mediterranean from the Atlantic may be traced in January and perhaps in September.

According to the data stated, *Salpingella acuminata* subsp. *glockentögeri* is probably to be considered indigeneous or, at any rate, always present in the Mediterranean in deeper layers. It seems to get in from the Atlantic from late autumn to winter, and to be able to propagate there, but disappears from the surface in late winter, and in summer is only present in deeper layers.

It was recorded for the first time for the Mediterranean by Entz sen. 1885 (p. 201, pl. 14 fig. 13); his figure seems to represent var. *attenuatus*.

2. SALPINGELLA DECURTATA n. sp. (Fig. 10).

Sts. 11, 14, 26, 28, 29, 31, 33, 40, 55, 68; 156 (250 m. wire), 184 (945 m. wire), 186 (245 m. wire and in Salpæ), 196, 199 (200 m.—80), 206 (1945 m. wire), 216, 218.

Besides the large and very long forms belonging to the preceding species, a very small one occurred more rarely in the Mediterranean (samples). Lorica similar in form to that of *Salpingella acuminata*, but less dilated above, with a narrow and outward bent rim of mouth, without a thickening of the wall or with only a faint or indistinct one. The aboral aperture is very narrow, narrower than in the preceding species, the plicate portion, however, similar in both. The number of plicae usually appears to be 4—6, sometimes more, up to 8; these numbers should, however, be considered uncertain. The plicae in all forms of the preceding species seem to be dextrorse — as in an ordinary screw, running upwards to the right, seen in front — in the present species they seem, however, to be twisted in the opposite direction. This may, however, also be left for further verification.

Among the many individuals which I saw of this species, there was only a single one, considerably larger than the usual, which might be considered uncertain and perhaps intermediate to small forms of the preceding species. The others were always quite distinct and obviously different.

Length 128 μ—150 μ, diameter of mouth 16 μ—23 μ, of lorica in the middle 12 μ—16 μ; length of plicate portion $^1/_3$—$^1/_4$ of total length of lorica.

This species was relatively most frequent in the winter plankton; in summer it was (apparently) very rare, and for the most part found only in deeper layers, like the preceding species. It was always very scarce; in Bay of Cadiz it was only taken at one station, in February, in the Atlantic Current only at one station in September.

As yet not otherwise known; it is, however, so small that it is probably much more frequent than samples taken with plankton nets would show.

AMPHORELLA Daday 1887.

Lorica closed at the posterior end. Wall as in *Tintinnus*, thin and simple (single), but frequently thickened above, very rarely in the middle; at these thickenings a more or less distinct outer and a similar inner lamella may be discerned, separated by an intermediate layer, apparently of a less firm consistence. No structure visible, or, at most, a very fine "primary" one.

The loricae in this genus often or generally seem to be very light and but little rigid; they are therefore frequently stiffened by ribs in the wall or plicae, sometimes with a thickened keel, or by a thickened and sometimes swollen caudal appendage.

This genus *Amphorella* seems to comprise a great many small species, hitherto only accidentally met with. It is, as here interpreted, still rather heterogeneous, showing connections with several of the other genera (*Favella, Undella, Rhabdonella, Tintinnopsis* and *Codonella*) by corresponding, but more primitive, forms.

The animalcule seems normally to have 2 macro- and 2 micro-nuclei (Laackmann 1911), answering to what is the case in most genera of Tintinnids.

1. AMPHORELLA QUADRILINEATA (Clap. et Lachm.) Jörg. (Figs. 11—13).

Jörgensen 1899 p. 12, pl. I fig. 2. Tintinnus quadrilineatus Claparède et Lachmann 1858 p. 201, pl. 9 fig. 3; T. amphora ibid. p. 199, pl. 8 fig. 3? T. amphora Brandt 1907, incl. vars. a, b (vix c), pl. 69 figs. 3, 4, 6, 7.

Sts. 11, 12, 14, 16, Naupaktos, 20, Taormina, 24, 25, 26, 28, 29, 31, 33, 36, 38, 39, 55, 62, 66, 68, 69; 79, 80, 126 (275 m. wire), 129 (80 m.—0 m., 600—0, 1100—0), 152 (250 m. wire, 950 m. wire), 154, 156 (250 m. wire, 950 m. wire), 160 (200 m.—100 m.), 165, 167, 170 (80 m.—20 m.), 175 (350 m. wire), 185, 186 (245 m. wire, 1145 m. wire), 187 (945 m. wire), 189 (945 m. wire), 194 (0 m., 1145 m. wire), 204 (1145 m. wire), 206 (0 m., 1445 m. wire), 209, 210, 215, 216, 218, 229, 231 (0 m., 1145 m. wire), 234 (25 m.—0 m., 100 m.—25 m.).

This species, widely distributed in temperate and warm seas, is now usually recorded as *Tintinnus* (or *Amphorella*) *amphora*, and I have myself (l. c.) pointed out that the latter species of Claparède et Lachmann may probably be the same as their *Tintinnus quadrilineatus*, established as a new species at the same time. It has, however, proved impossible to identify any Tintinnid occurring on the west coast of Norway with their figure quoted. Also, they state its length to be 200 μ—300 μ, which is considerably more than the length of the greatest Norwegian forms. No corresponding form is found anywhere at all. The only safe specific name is therefore *quadrilineatus*; the corresponding figure in Claparède et Lachmann answers very well to the Norwegian forms, also in regard to dimensions (according to the magnification stated).

Daday (1887) figures from the Mediterranean two forms (pl. 18 figs. 4, 5). Strange to say, he has not seen the three, well-defined longitudinal edges, so characteristic for this species, though he considers fig. 5 to be *Amphorella quadrilineata*. This figure of his is, however, so different from our Norwegian species that I have previously (l. c.) found it necessary to establish this form as a new species, *Amphorella dadayi*, whereas his fig. 4 obviously represents a form of the true *Tintinnus quadrilineatus*.

The present species proved to be rather frequent in the Mediterranean, particularly during the winter cruise, when it was present at 18 of the 37 stations there, though nearly always but singly or in very small numbers. It was relatively most frequent in the Tyrrhenian Sea; here also in somewhat greater numbers at two northern stations (31, 33). During the summer cruise it appeared sporadically throughout the Mediterranean, as far as into the Sea of Marmora, (in deeper layers), but proportionately les frequent than in winter, taken in all at 22 of the 102 stations, and nearly ewerywhere found for the most part only below the surface. Also in summer it was everywhere scarce, whilst at st. 80, in Bay of Biscay, it was rather plentiful.

In the material in question only a faint trace of immigration into the Mediterranean from the Atlantic, in September, is to be seen (present at st. 218 on the coast of Africa); in June the species was absent all the way from the Bay of Biscay to the Tyrrhenian Sea, and in February it was certainly present in Bay of Cadiz (almost ewerywhere), but absent in the Atlantic Current along the north coast of Africa. It is probably but rarely that it gets safely in through the Straits (in late autumn?) and may therefore be considered an indigeneous Mediterranean species.

This is also apparent from the fact that it occurs in two rather different forms, connected by rare intermediate ones. One of them is a larger form (fig. 11), answering very well to *Tintinnus amphora* var. *brasiliensis* Laackm. (1911 p. 485, pl. L fig. 11), but also to the figure of *T. quadrilineatus* in CLAPARÈDE et LACHMANN, at any rate sufficiently to permit its being referred to the typical form of this widely distributed species. The special name var. *brasiliensis* ought, at any rate, to be abandoned — if not used as α *brasiliensis* for the main species — its distinguishing character, a vesiculous inward "dilation of the

Fig. 11. *Amphorella quadrilineata* (Clap. et Lachm.); $^{350}/_{1}$. St. 26. a. Lorica resting on a face, b. on an edge. Fig. 12. *Amphorella quadrilineata* (Clap. et Lachm.) *var. minor* n. var.; $^{350}/_{1}$. a st. 26, b st. 38. Fig. 13. *Amphorella quadrilineata* (Clap. et Lachm.); $^{350}/_{1}$. St. 38. A small, deviating form. Fig. 14. *Amphorella laackmanni* n. nom.; $^{350}/_{1}$. St. 186, in Salpæ. In fig. b the inner optical longitudinal section is shown. c showing the supposed shape of a cross-section of lorica in its lower portion. Fig. 15. *Amphorella tetragona* n. sp.; $^{350}/_{1}$. St. 206, 945 m. wire. The (inner) optical longitudinal section is shown. Fig. 16. *Amphorella steenstrupi* (Clap. et Lachm.) Dad.; $^{350}/_{1}$. St. 25. Fig. 17. *Amphorella pyramidata* n. sp.; $^{350}/_{1}$. St. 186, in Salpæ. Fig. 18. *Amphorella intumescens* n. sp.; $^{350}/_{1}$. St. 156. Fig. 19. *Amphorella gracilis* n. sp. ad int.; $^{350}/_{1}$. St. 187, 945 m. wire. Probably the upper half of an incomplete individual of *Amphorella intumescens*, perhaps of a lorica still unfinished. Fig. 20. *Amphorella pachytoecus* n. sp.; $^{350}/_{1}$. a st. 186, in Salpæ; b st. 26, c st. 25. Fig. 21. *Amphorella trachelium* n. sp.; $^{350}/_{1}$. St. 206, 1945 m. wire. Fig. 22. *Amphorella ganymedes* (Entz sen.) Dad.; $^{350}/_{1}$. a and b st. 186, in Salpæ; b *var. bulbosa* (Bdt.). c *var. bulbosa* (Bdt.) st. 26; d *A. ganymedes* f. *acuta*, st. 218. Fig. 23. *Amphorella oxyura* n. sp.; $^{350}/_{1}$. St. 14. Fig. 24. *Amphorella torulata* n. sp.; $^{350}/_{1}$. St. 186, in Salpæ. Fig. 25. *Amphorella urceolata* (Ostf.); $^{350}/_{1}$. St. 187, 945 m. wire. b the supposed side view; not figured by means of camera lucida.

inner lamel" being only an optical delusion, frequently seen in larger forms of the present species and caused by the slightly irregular shape and oblique position of the truncate, triangular antapex, in connection with a strongly protruding longitudinal edge.

The other Mediterranean form (fig. 12) is much smaller, and has a more outward curved orificial rim. Its lorica is narrower at the constriction above, but otherwise of more equal width, or even slightly dilated below the middle, not almost conically narrowing as in the larger form. It is most easily known from the other form by the posterior end lacking the well defined large, triangular, truncate antapex of that form, but obtuse, with a small, truncate end, or often apparently somewhat rounded. It answers well to *Tintinnus amphora* in Entz sen. 1884, pl. 24 fig. 20, which he considers the same as *T. quadrilineatus* Clap. et Lachm., only lacking the "furrows".

These two Mediterranean forms do not answer well to the figures in Daday (1887). The smaller one, var. *minor* n. var., is usually less than 100 μ in length, about 80 μ to somewhat over 100 μ (76—105 μ) according to a smaller number of measurings, with a diameter of mouth about 40 μ—46 μ, and with a secondary, often but slightly pronounced, maximum of diameter about the lower $^1/_3$—$^1/_4$, whilst the larger form usually is 140 μ—170 μ (120 μ—200 μ, rarely still shorter), by a diameter of mouth = 50 μ or more, a more upwards directed rim, with a secondary maximum of diameter slightly below the constriction (above), long and strongly developed pliese and a very conspicuous, truncate and triangular antapex, 15 μ broad or more. Laackmann (l. c.) has stated the number of nuclei to be two macro- and two micronuclei, whereas Daday (1887) gave it as four macronuclei.

Faure-Fremiet (1924 pp. 110—112, fig. 111) found that the animalcule, fixed by a short pedicle at the truncate antapex, had when swimming a narrowly oblong shape, a slightly dilated and rather high peristome collar with rounded lobes, "about" 18 membranelles, a high, "movable" piston and a more or less strongly oblique position of the peristome. The form figured by him is the same as the greater Mediterranean one.

In my opinion this well known form should be considered the main species. At any rate it will be necessary to abandon the *Tintinnus amphora* of Claparède et Lachmann as the type of species, considering that a corresponding form is not yet found, whereas the region in question has been very well explored. Brandt, it is true, figures a great Atlantic form, identifying it, without an explanation, with the obscure species in question. I know this Atlantic form, which is very well figured (Brandt l. c. fig. 6); it bears, however, no other resemblance to Claparède's species than that of being a more lengthened form than the usual forms of *Amphorella quadrilineata*. It differs from the figure in Claparède et Lachmann in having a broader and much more strongly outward bent oral rim, a pronounced thickening of wall (above), a different shape in consequence of the secondary maximum of diameter being situated much farther down, and a different length, being proportionately great (145 μ—190 μ), but not yet great enough. I should proprose to name this form var. *brandti* (of *Amphorella quadrilineata*).

In regard to the figures in Daday (1887) Laackmann has already pointed out that the "var. *brasiliensis*" answers very well in shape to the fig. 5 in Daday, his *Amphorella quadrilineata*. Having seen the material of the Thor, I agree absolutely with Brandt in abandoning the name *Amphorella dadayi*, the figure in Daday being very misleading as to details (no thickening above, evenly rounded posterior end etc.). Brandt lists it as a special variety; it is, however, obviously a merely accidental form, differing from the larger of the two Mediterranean forms in its strikingly small dimensions (length 72 μ) and a more pronounced constriction above. I have seen such a form or individual (st. 38), only 71 μ in length, but generally answering to the larger Mediterranean form as well as to the fig. 5 in Daday (see fig. 13).

The other figure (4) in Daday is somewhat similar to var. *minor*, the dimensions (in Daday) and the more erect orificial border answer, however, better to the larger form.

Both Mediterranean forms were present in winter as well as in summer, the var. *minor* chiefly in the inner regions as well as in the northern and north-western, the larger predominant or present alone outside the Mediterranean. During the summer cruise, the species being very rare at the surface, but frequent in deeper layers, var. *minor* was always apparently the only superficial form, while the larger, the main species, was found partly alone in the deeper waters, partly together with v. *minor*.

On this account it seems to me possible that the smaller form, v. *minor*, is a special warm-water form, indigeneous in the Mediterranean and perhaps wholly or partly (i. e. originally) developed from invading larger forms, as particularly adapted for life in the surface. The larger forms, probably to a great extent only recently immigrated into the Mediterranean from the Atlantic, are in summer only present at deeper levels, particularly in the Eastern Mediterranean where they were found at nearly all stations where deep water samples were taken.

This species has a wide distribution in northern temperate waters, though generally occurring in very small numbers; the German "Plankton-Expedition" (1889) found it, however, abundantly in the Eastern Irminger Sea, south-southeast of Iceland. Otherwise it is known from numerous localities of the warmer and temperate Atlantic regions, all the way from 24° S, exceptionally 42° S, until far to the north. It is recorded for the Indian and the Pacific Oceans, but not for their cooler regions. It was already reported for the Mediterranean by Entz sen. (1884).

2. AMPHORELLA LAACKMANNI n. nom. (Fig. 14 p. 17).

Lorica beautifully urn-shaped, somewhat protracted, slightly and gradually dilated towards the mouth, with maximum of diameter about at the lower $^1/_3$; at the posterior end truncate. Lorica acutely quadrangular on account of four alary plicae, partly extending along the whole length, partly consisting of a longer portion, extending from the lower end up towards the constriction above, and a shorter upper, from the orificial border downwards, these two portions, apparently, not running exactly over into each other (see fig. 14 a). On the optical cross-section (fig. 14 c) the sides of lorica appear concave (outwards); in side view, two strong inner ribs or lines, with double outlines, appear, corresponding to the optical longitudinal section.

Length 66 μ, diameter of mouth 20 μ.

Only a couple of individuals seen, in stomachs of Salpae from st. 186 (Ionian Sea).

This species is so strikingly similar to the socalled *Tintinnus amphora* var. *dadayi* Laackmann (1911 p. 486, pl. L fig. 12) that I must provisionally consider them synonymous, in spite of several noticeable differences, according to Laackmann's description and figure. He finds 8 plicae, distinctly running from mouth to posterior end, but "not exactly straight", and describes the end of the lorica as obtusely pointed. By the very few individuals seen it is very well possible that the number of plicae may become greater on account of intermediate ones being developed, or perhaps the two groups of upper and lower plicae may pursue their ways without merging into each other.

Laackmann's species is somewhat smaller than the Mediterranean (length 54 μ). It was found in plankton from St. Helena (German South-Pole Exp., $^1/_9$ 1903).

3. AMPHORELLA TETRAGONA n. sp. (Fig. 15 p. 17).

As to habitus very similar to the preceding species, but different in having a strongly dilated and outward curved mouth, as well as a lorica, not distinctly urn-shaped and with a very short posterior point, truncate at the very end. The "ribs" appearing on the optical longitudinal section, as well as the four alary plicae, are so similar to those in the preceding species that the present immediately gives the impression of being only a larger form of the same. Nevertheless, the difference is so considerable that they must provisionally be considered different species.

Length 123 μ, diameter of mouth 47 μ. As in the preceding species a (distinct) thickening of wall is lacking.

I believe also to have seen a lorica with 6 alary plicae.

St. 206, 1945 m. wire (Balearic), singly.

4. AMPHORELLA STEENSTRUPI (Clap. et Lachm.) Dad. (Fig. 16 p. 17).

Daday 1887 p. 537, pl. 18 figs. 9, 21. Tintinnus steenstrupi Claparède et Lachmann 1858 p. 200, pl. 8 fig. 5.

Sts. 12, 18, 25, 26, 27, 28, 29, 31, 33, 38, 39, 40, 55, 60, 66, 68, 69; 79, 80, 95, 96, 97, 109, 122 126 (275 m. wire), 137, 140, 152 (250 m. wire), 186 (in Salpæ), 190, 204, 206 (1945 m. wire), 210, 213, 229, 231 (0 m. and 1145 m. wire), 234 (0 m., 25 m.—0 m., 100 m.—25 m.), 235, Lisbon.

Wall of lorica, as in *Amphorella quadrilineata*, more or less strongly thickened above. Length remarkably varying, which is also emphasized by Brandt (1907); the Mediterranean specimens are throughout much shorter than the northern, longer lorica being, however, occasionally met with also in the Mediterranean. Otherwise a rather constant species, particularly as to development of the lower end, which is short and broadly conical, with the lateral outlines nearly perpendicular to each other, the extreme end rounded.

During the winter cruise it was very rare and scarce in the Eastern Mediterranean, only noted for two stations; in the Tyrrhenian Sea it was, however, frequent, being present at nearly all stations, though but singly or in very small numbers, only at st. 31 somewhat more numerous. Farther to the west it was (apparently) lacking until some few stations near the south coast of Spain, whilst outside the Straits it was present at 3 of 5 stations in Bay of Cadiz. No immigration into the Mediterranean from the west seems traceable in February (nor in January).

During the summer cruise it proved to be very rare everywhere in the Mediterranean, in all only present singly at 4 stations in the Eastern Mediterranean and at 8 in the Western. In Bay of Biscay it was met with in greater numbers in June at sts. 79, 80, but in Bay of Cadiz (in June) scarce, whilst in September it was present here at both stations. Along the coast of Africa it was only taken at st. 109 (in June), so that there is only a faint trace of immigration into the Mediterranean from the Atlantic in June.

The lorica figured belongs to the shorter form; its length was 117 μ, diameter of mouth 40 μ. The northern forms are on an average about 50 % longer, up to 200 μ and more.

The longer form, more answering to that occurring in northern waters and in the Atlantic, was seen from st. 152, 945 m. wire, and is otherwise only noted for st. 31, here together with the short form, and for st. 206, 1945 m. wire.

This species must very probably be considered indigenous in the Mediterranean; remains of the animalcule in the lorica were occasionally seen. Presumably it gets in occasionally from the Atlantic (in late autumn?), may keep alive in the Mediterranean for some time and perhaps multiply, giving rise to the development of the shorter forms, which are predominating. But it does not seem to thrive easily in the Mediterranean waters, at any rate in summer, being generally very scarce.

It was first reported from the Mediterranean by Daday 1887, from Naples, later from the Alboran Sea in February (Cleve 1903 b), from Syracuse (Lohmann 1903, 1908) and from the northern Adriatic (Entz 1909, Laackmann 1913, Theodoro 1922).

Otherwise it has a wide distribution in the Atlantic and in the Indian Oceans, in the former from 46° S. to the Barents Sea, seems, however, allways to occur sparsely.

5. AMPHORELLA PYRAMIDATA n. sp. (Fig. 17 p. 17).

A small species with a thin-walled lorica, a proportionately wide, semi-erect mouth, distinctly offset from the lorica and forming a sort of collar, yet without an inward protruding rib at its base. Wall somewhat thickened from this base in an upward, as well as in a downward, direction. Lorica slowly narrowing in the lower half to an offset, low conical and very thin-walled portion, at the very end with a slightly protruding mamilla. Length 54 μ, diameter of mouth 28 μ.

From stomachs of Salpae, st. 186, singly.

6. AMPHORELLA INTUMESCENS n. sp. (Fig. 18 p. 17).

Lorica long and narrow, thin-walled, with exception of a shorter middle portion which is thickened, merging slowly and very gradually into the thin-walled parts above and below. Above, towards the mouth, the lorica is more rapidly dilated, but without a distinctly offset collar and without a thickening of the wall. Below the median thickening of wall the lorica is slowly narrowing, showing a few — presumably four — long and not very conspicuous longitudinal plicae or striae. At the posterior end (apparently) rounded and very thin-walled (perhaps unfinished).

The figured individual was 198 μ in length, diameter of mouth = 37 μ.

I only saw two loricae; the second, not figured, was open below, not very far below the characteristic median thickening, which was identical with that in fig. 18. This lorica gave the impression of being broken or unfinished.

St. 156, 250 m. wire (fig. 18); st. 152, 250 m. wire.

This species and the preceding one being only observed as empty loricae, it is not altogether certain that they really belong to the Tintinnids. The latter species recalls *Stichotricha inquilinus* Entz sen. (1884, pl. 24 fig. 22), *Amphorella inquilina* Dad. (1887). Somewhat answering in shape is also *Tintinnus amphora* Clap. et Lachm.

I have not tried to identify my species with Entz's, the latter being figured with a thickened, double oral portion (perhaps after fission?, compare fig. 79 below).

7. AMPHORELLA GRACILIS n. sp. ad int. (Fig. 19 p. 17).

Is probably an unfinished lorica belonging to the preceding species. I will, however, designate it by a special name, in order to draw attention to it. It is perfectly similar to the upper $^1/_3$ of the lorica in the preceding species; there is, however, (still) no trace of the peculiar median thickening of wall. The lower end was apparently exceedingly thin-walled; in such a case it is very difficult to decide whether the lorica is really open below or not. The two striae figured may answer to those in the preceding species; it is again very difficult to make out whether they are situated on one or both sides (the foremost or the hindmost),

If this really is an unfinished lorica of the preceding species, it will prove that the formation of the lorica takes place from the upper to the lower end.

St. 187 (Ionian Sea) 945 m. wire, one lorica.

8. AMPHORELLA PACHYTOECUS n. sp. (Fig. 20 p. 17).

Sts. 25, 26; 186 (in Salpae). Everywhere singly.

Lorica beautifully calyciform, below acuminate and ending in a solid, spine-like caudal prolongation. Wall thick, with rather well developed limiting lamellae; it is particularly thick at the base of the dilated oral portion, then decreasing in thickness downwards to the posterior end. On one lorica fine longitudinal striae (or plicae) were seen (fig. 20 c), equi-distant as in *A. ganymedes*.

The thickness of wall is considerably varying; specimens from stomachs of Salpae had often a rather thin wall and a lesser thickening of wall below the mouth.

Total length 98 μ—104 μ, length of caudal prolongation up to 12 μ; diameter of mouth 32 μ—34 μ.

At first I mistook the proportionately thin-walled individual figured in fig. 20 a for *Amphorella acuta* Schmidt (1901 pp. 184, 185, fig. 2), a species which is different from the similar *A. quadrilineata* in having a pointed posterior end. Later I found the more thick-walled individuals, which as to constitution of wall strikingly recall species of *Undella*. This latter genus has, however, much thicker lamellae, separated through a layer which Brandt reported as showing a fine primary structure. The corresponding layer in

the present species gives the appearance of being of firmer texture, not so different from the lamellae, which also are less distinctly limited inwards, whilst in the genus *Undella* this intermediate layer — if really always filled by a solid substance — seems to be much less consistent, the inner lamellae in some cases easily becoming detached. A very fine "primary" structure between the lamellae must be difficult to distinguish from a similar structure of the lamellae themselves.

This species is as yet otherwise unknown.

9. AMPHORELLA TRACHELIUM n. sp. (Fig. 21 p. 17).

Lorica of a striking shape: above a collar-like oral rim, distinctly set off, at its base strongly spreading, then ascending. Lorica proper is slowly narrowing downwards, then more rapidly passing into a rather long, acute caudal prolongation. Wall apparently simple (single) and rather thin (but rigid), at the collar not or very slightly thickened, showing on its outside fine longitudinal striae (or plicae?), nearly parallel and equidistant.

Total length 96 μ, of collar 15 μ; diameter of mouth 42 μ, at the base of collar 25 μ; caudal prolongation about 26 μ.

On one lorica a few agglutinated foreign bodies were seen.

St. 206, 1945 m. wire.

May be synonymous to *Tintinnus conicus* Bdt. (1907 p. 413, pl. 69 fig. 10), from the Guinea Current and the South Equatorial Current.

10. AMPHORELLA GANYMEDES (Entz sen.) Dad. (Fig. 22 p. 17).

Daday 1887 p. 539, incl. var. cylindrica p. 540. Tintinnus ganymedes Entz sen. 1884 p. 409, pl. 24 figs. 17, 18; Brandt 1907 p. 412, pl. 70 fig. 2. T. bulbosus Brandt l. c. figs. 4, 5, incl. var. a, p. 413, fig. 3.

α *tenuicauda*: sts. 68, 69; 126 (275 m. wire), 186 (in Salpæ); 199 (200 m.—80 m.), 212, 218.

var. *bulbosa*: sts. 14, Naples, 26, 28, 29, 31, 33, 39, 40; 152 (250 m. wire), 186 (in Salpæ), 194 (1145 m. wire), 204 (945 m. wire), 206 (1945 m. wire), 209 (945 and 1945 m. wire), 246.

Lorica thin-walled, rather narrowly poculiform, usually slightly dilated towards the mouth and here showing 8—12, slightly oblique ribs, running downwards from the border of mouth — where stronger — to upper $^1/_4$—$^1/_3$ or slightly more, where they gradually disappear; sometimes there are fainter and shorter, intermediate, ribs (see fig. 22 c). In a downward direction the lorica is narrowing slowly, below passing over into a very varying caudal prolongation, which may be rather long, of equal breadth and rounded at the end (see fig. 22 a and Entz l. c.), or shorter and swollen up to a spherical end (see fig. 22 b, Daday l. c., fig. 18 and Brandt l. c. fig. 3), or again evenly attenuated to a narrow and acute caudal prolongation (see fig. 22 d).

Is remarkably varying, partly in regard to the development and number of the thickened striae or supporting ribs in the upper part of lorica, partly and especially as to length and development of the caudal prolongation. Brandt has two species, *Tintinnus ganymedes* "Entz" (Brandt l. c. fig. 2), answering to my fig. 22 c, only with a single point at the lower end of the sphere, with var. a Brandt (l. c. fig. 3), my fig. 22 b, as well as fig. 18 in Daday (1887).

I have got the impression that there are many forms, not permitting an unconstrained grouping into Brandt's two species. Taking no regard to the varying of striae one might provisionally arrange the forms mentioned into two varieties (a main species and one variety), α *tenuicauda*, with two forms, f. *obtusa* (fig. 22 a, answering to the fig. in Entz l. c.) and f. *acuta* (fig. 22 d, Brandt's *T. ganymedes*), and var. *bulbosa* (Bdt.) (fig. 22 b, c).

Amphorella ganymedes proved, on the whole, to be rare in the Mediterranean. During the winter cruise it was taken frequently, but sparsely, in the Tyrrhenian Sea and near to the border of the Ligurian,

otherwise, however, only at st. 14 in the Adriatic. In summer it seemed to be almost exclusively present in deeper layers, to the east as far as to the coast of Barca, only noted for two surface samples (sts. 212, 218, *α tenuicauda*). In the Bay of Cadiz it was only taken in February, sparsely at two stations. In September it was present (as *α tenuicauda*) at the st. 218 near the coast of Africa, which may be suggestive of a very faint immigration into the Mediterranean from the Atlantic of the main species, which also is the form noted from Bay of Cadiz in February. The most frequent form in the Mediterranean was var. *bulbosa*, which perhaps may be a heavier form, adepted for life in deeper layers.

Is probably to be considered endogenous in the Mediterranean, though rare and scarce and passing over into deeper water towards summer. It is probably partly maintained through immigration from the Atlantic into the Mediterranean, as the main species in upper layers and western regions, and possibly in part developing the var. *bulbosa* (by intermediate forms) farther in.

Is one of the delicate species which seem more closely confined to the surrounding water and are easily washed away with it, appearing relatively rarely and sparsely in the samples. It has a wide distribution in the warmer and warm-temperate regions of the Atlantic, all the way from 21° S as far as off the south coast of Ireland, being particularly frequent across the Atlantic between 39° N and 50° N (Cleve 1901 d). Also known from Bay of Aden, Arabian Gulf and Bay of Bengal.

11. AMPHORELLA OXYURA n. sp. (Fig. 23 p. 17).

St. 14 (Adriatic, Decbr. 1908), singly.

Lorica hyaline, campanulate, not or very slightly dilated towards the mouth, which shows a double rim, a narrow, outward directed one, and a similar, erect inner. Wall apparently single, rather thin. Lateral outlines of lorica almost parallel or very slightly converging in a downwards direction, somewhat above the lower $^1/_3$ rapidly converging into a short and very acutely pointed caudal prolongation. No structure seen.

Length 40 μ, diameter of mouth 28 μ.

Considerably similar to *Amphorella*(?) *antarctica* Cleve (1901 a, p. 921 fig. 1), presumably synonymous to *Cymatocylis parva* (Laackm. 1907) Laackm. 1911, both of which are nearly allied to *Cyttarocylis obscura* Brandt (1906 pl. 62, figs. 1, 5). These species, from the sea south of Africa, from the Antarctic and from the coast of Brazil, are all of them larger.

12. AMPHORELLA TORULATA n. sp. (Fig. 24 p. 17).

St. 186 (Ionian Sea), in Salpae.

Lorica recalls that of the previous species, but has a higher (broader) inner rim of mouth, somewhat less protruding outer rim, and is below short conical with a very obtuse, almost rounded end.

Length 28 μ—31 μ, diameter of mouth 23 μ.

One lorica seemed to be coarsely uneven outside, having alternately elevated and depressed parts, appearing darker or brighter. *Cyttarocylis obscura* Bdt. has perhaps a similar structure (see Brandt 1901 p. 201).

13. AMPHORELLA URCEOLATA (Ostf.) (Fig. 25 p. 17).

Tintinnus urceolatus Ostenfeld 1899 b, p. 439 fig. 2 f; Undella(?) urceolata Cleve 1901 d p. 126.

St. 187 (Ionian Sea), 945 m. wire, singly.

Wall of lorica (apparently) structureless, hyaline and single, but proportionately thick. At the upper $^1/_4$ the lorica is provided with a strongly marked, protruding annular rib (or edge); above it, the lorica is rapidly narrowing to an erect mouth of considerably smaller diameter, below the rib it is also

narrowing, at first slowly, then, at the lower 1/4, more rapidly to a short and broad posterior portion, ending in a low and rounded mamilla.

Length 43 μ, diam. of mouth 32 μ, maximum diameter 42 μ.

Not quite answering in shape to the figure in OSTENFELD, seems, however, to be the same or a nearly allied species.

OSTENFELD's species has been observed at several localities in the northern Atlantic, from 45° N (15° W) to 56° 39′ N (27° 24′ W) and to 34° W (51° N).

Tintinnus urceolatus var. *α* BRANDT 1907 p. 408, pl. 62 fig. 3 does not belong to the present species; see *Metacylis mediterranea* below.

PTYCHOCYLIS Brandt.

BRANDT 1896 p. 59; 1907 p. 273 p. p.

Wall of lorica (apparently) simple (single), without distinctly developed or separated outer and inner lamellae, outside reticulated with irregular small meshes of finer or coarser elevated plicae, otherwise only with a fine "primary" structure. The optical section of wall shows an apparently homogeneous wall, only with the fine "primary" structure mentioned. No collar, nor any helicoidal portion of wall above, but frequently denticulated at the oral aperture. Loricae broadly campanulate, with or without a caudal prolongation.

The animalcule is proportionately large, short and broad, fixed at the posterior end by a strong, rather thick, pedicle, in a swimming state about as long as the lorica, with 16 powerful membranelles and 4 macronuclei.

This is a very natural genus, comprising nearly allied, northern temperate and arctic species. BRANDT 1907 included in it a great number of quite different species, only on account of their loricae having elevated plicae outsides. (See genera *Rhabdonella* and *Epiplocylis* below).

No species of this genus was met with in the material of the "Thor".

HELICOSTOMELLA n. gen. (ad int.).

Wall of lorica below apparently simple, above evenly and imperceptibly passing over into an "annulated" portion, cylindrical and formed by a single, narrow, closely twisted helicoidal band with numerous, superposed turns, in contact with each other and coalescent at their lower and upper edges, which form a single, spirally twisted line on the outside of the cylinder, right to the mouth, or, properly, from the mouth downwards, where it gradually becomes indistinct. (This very frequent structure in the Tintinnidae I will in the following simply call "annulated", for the sake of brevity. The term "annulus" means a single turn of the band). The upper "annuli" are usually a little overlapping in an upward direction, and frequently dentate. Only a fine, "primary" structure, in well developed specimens mostly visible above, where also two lamellae may be more or less distinctly discernible.

The animalcule of the following species is cylindrical, in a swimming state (obliquely) protruding, with long and narrow membranelles and, outside them, long, supporting setae (FAURÉ-FREMIET 1924 p. 109 fig. 35). 2 macro- and according to LAACKMANN (1906), 2 micronuclei; the animalcule is fixed by a long and narrow pedicle to the lateral wall, about where the lorica narrows into the caudal prolongation.

To this new genus may provisionally be referred a series of thinwalled loricae, as *Cyttarocylis annulifera* Ostf. et Schm. (1901) and similar species. The very variable *Favella azorica* seems to form a transition between the present, provisional genus and the genus *Favella* (or *Undella?*).

HELICOSTOMELLA SUBULATA (Ehrb.) (Fig. 26).

Tintinnus subulatus Ehrenberg 1834 p. 274, 1838 pl. XXX fig. III. Amphorella subulata Daday 1887 p. 536, pl. 18 fig. 7; Faure-Fremiet 1924 pp. 108—110, fig. 35 ("var. edentata").

Sts. Naples; 84, 169, 170 (20 m.—0 m., 80 m.—20 m.), Constantinople, 171 (0 m.), 172 (17 m.—0 m., 50 m.—17 m., 200 m.—51 m.), 175 (350 m. wire, 1150 m. wire), Barcelona, 212.

This species, rather common in northern waters, was very rare in the material of the "Thor", from the Mediterranean. It usually occurred only as a small form, rather similar to var. *kiliensis* Laackmann (1906 p. 17, pl. I, figs. 1, 2). In the winter samples I saw it only from off Naples, and in the summer samples from the Mediterranean proper I only found it in two samples from the Catalonian Sea, everywhere but singly. In the region of the Black Sea it was frequent, though also there not very numerous.

Is a neritic species which seems to be widely distributed also in more southerly waters, but in deviating forms. Whilst the northern form may become over 500 μ long, the specimens seen (by myself) from the Mediterranean proper were but 120 μ or shorter; Daday states 108 μ—195 μ. The diameter of mouth is 20 μ—26 μ. The specimens from the Black Sea region are generally somewhat more similar to the northern form; the figured individual from the Sea of Marmora was 340 μ long × 23 μ wide at the mouth.

Was first reported from the Mediterranean by Gruber (1884), from Genoa. It is sometimes confounded with *Tintinnopsis radix*, which is, however, almost twice as wide (conf. Laackmann 1913).

I have also seen specimens from the east coast of Arabia (21° 50′ N 59° 25′ E) and from the Red Sea (18° 10.′5 N, Handel-Mazzetti, Octob. 1910).

In the northern forms of this species one may sometimes find loricae distinctly showing a later prolongation by new helicoidal portions at the mouth, off-set from the older growth. The same is to be seen in fig. 26 b, with an earlier oral aperture near the upper end of the lorica.

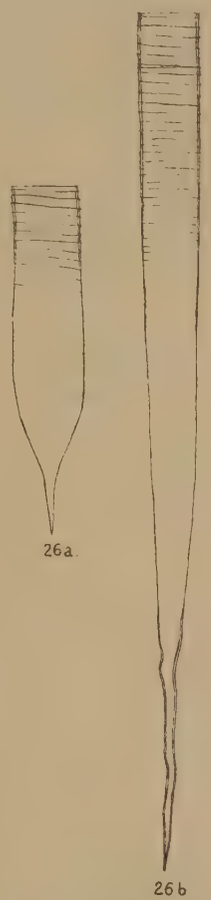


Fig. 26. *Helicostomella subulata* (Ehrb.); $^{350}/_{1}$. a Barcelona Harbour; b st. 170, 20 m.—0 m.

FAVELLA n. gen.

Wall of lorica with well developed and distinctly separated lamellae, and usually a single, sometimes, or in parts, two or more intermediate layers of "prismatic elements" the lateral walls of which appear on the optical (longitudinal) section of the lorica as short cross-lines, connecting the outer and the inner lamellæ ("*Cyttarocylis*-structure").

No "collar" (as in *Cyttarocylis*); nor helicoidal structure, save in certain forms of the two species *F. ehrenbergi* and *F. azorica*. Frequently a dentate mouth.

The structure described is usually a more or less coarse "secondary" structure, accompanied by a very fine "primary" one. In some species only a single structure, of relatively coarse "primary" elements, has been observed.

The animalcule seems always (in a normal or resting stage) to possess 2 macronuclei, and probably 2 micronuclei; the number of membranelles is in several cases stated to be 18.

Here belong the rest of the old-established genus *Cyttarocylis*, after the separation of *Xystonella*, *Xystonellopsis*, *Coxliella* and the genus *Cyttarocylis* proper. *F. serrata* may be considered the type-species.

1. FAVELLA SERRATA (Möb.) (Fig. 27 p. 27).

Möbius 1887 p. 120, pl. VII fig. 40. Cyttarocylis serrata Bdt. 1896 p. 60, 1907 p. 204, pl. 39 figs. 1—6. Fauré-Fremiet 1924 pp. 102—105, fig. 33.

Sts. 84 (0 m., 25 m.—10 m.), 85 (abundant), Cadiz, 113 (several specimens), Barcelona, Lisbon, 239, Brest. Scarce, when not otherwise mentioned.

Lorica large, pallid, somewhat below the mouth more or less distinctly swollen, not or only slightly narrowing in the upper half, then more rapidly and below abruptly or more evenly passing into a shorter or longer, mostly thick, very thick-walled and obtuse, rarely acutish, caudal prolongation, showing a narrow channel inside. Lamellae of the wall thick and approximated. At the mouth numerous, triangular denticles. Structure of pallid meshes, varying in size, near the mouth very small.

Length of lorica proper 183 μ—306 μ, of the caudal prolongation 26 μ—77 μ; diameter of mouth 85 μ—96 μ, number of teeth 60—70, broad and short.

In northern specimens the dilation below the mouth may be indistinct or wholly lacking (var. a Bdt. l. c.); sometimes there is no denticulation. Has in same cases been confounded with *F. ehrenbergi*, which, however, is usually larger, has no denticles, nor any dilation above, has a solid caudal prolongation (without inner channel) and a thicker wall (of lorica).

Favella serrata is a neritic, meroplanktonic species, very scarce and rare in the material of the "Thor" from the Mediterranean, only noted from Barcelona and st. 113, in the latter locality but two, small individuals seen.

Otherwise known from the coasts of the German Ocean and thence to the Western Baltic, the Norwegian coast as far as Tromsö, the west coast of Scotland, the Channel, the Bay of Biscay, the west coast of Portugal and the Bay of Cadiz. Farther to the south, along the west coast of Africa a variety (var. a Bdt.) is occurring, as well as a very closely allied form or species, *Favella arcuata* (Bdt., p. 207, pl. 40, figs. 2—7).

Was first reported from the Mediterranean by Entz jun. 1909 (from Naples); his figure (pl. X fig. 10) and description of the animalcule (p. 133) are, however, different. Forti (1913) reports it from the coasts of the Sea of Marmora. I did not see it in the material of the "Thor" from the Black Sea region.

2. FAVELLA AZORICA (Cl.) (Figs. 28—30 p. 27).

Undella azorica Cleve 1900 d p. 974. U. campanula Schmidt 1901, p. 190 fig. 6.

Sts. 160 (0 m.), 167, 179, 182 (0 m.), 190, 195, 202, 206 (0 m., 1945 m. wire), 210, 217, 218, 220, everywhere only singly or very few individuals.

Lorica in the upper half nearly cylindrical, not, or but slightly dilated at the mouth, maximum diameter about in the middle, but not much greater than that of the mouth, about the lower $^1/_3$ with rounded side outlines rapidly narrowing to a conical, usually somewhat protracted posterior point, obtuse or slightly rounded at the very end, or more or less developed into a short and thick, rarely longer and narrower, caudal prolongation. At the mouth a narrow, thin-walled annulus which may develope into an "annulated" thick-walled anterior portion (of lorica), consisting of up to 4, rarely more, rather narrow "annuli", in the optical section of the wall showing short and thick segments (fig. 29). Wall of lorica with thickened and distant lamellae, approximated in the lower part, but separated right to the posterior end, where the inner lamella is rounded off. Structure more or less distinct, consisting of fine, punctiform meshes, of almost equal size all over the wall, at the very end more pallid and perhaps smaller. Caudal prolongation, when present, solid, coarsely punctate inside.

Length of lorica proper 94 μ—96 μ, when "annulated", up to 117 μ, caudal prolongation of very varying length or absent, diameter of mouth 60 μ—85 μ, wall of lorica up to $2^1/_2$—3 μ thick (in the upper $^2/_3$).

The dimensions given by Schmidt for his *Undella campanula* are obviously erroneous; by comparing with his fig. 5 (l. c. p. 189) which is drawn under the same magnification we get 120 μ (length of

lorica proper) × 72 μ (diameter of mouth), instead of 258 μ × 141 μ stated by him. His form is a long one, with an extraordinarily developed caudal prolongation (about 34 μ) and therefore rather dissimilar to CLEVE's typical form; I think, however, they will prove to belong together.

There are three different forms: the main species, without "annuli" and without caudal prolongation, var. *campanula* (Schm.), with a more or less developed caudal prolongation and with a single annulus, and var. *composita* n. var., with several (4 or more) "annuli", with (or sometimes without?) a caudal prolongation. The latter variety is noted for sts. 206 (0 m.), 210, 217. Also in the Persian Gulf. Was rare, and scarce in the material of the "Thor".

An immigration from the west into the Mediterranean seems to take place in September; certainly, the species was not observed in the Bay of Cadiz; it is, however, present at the Azores in September, and the occurrence at sts. 218 and 220, must therefore, I believe, be due to individuals entering through the Straits of Gibraltar.

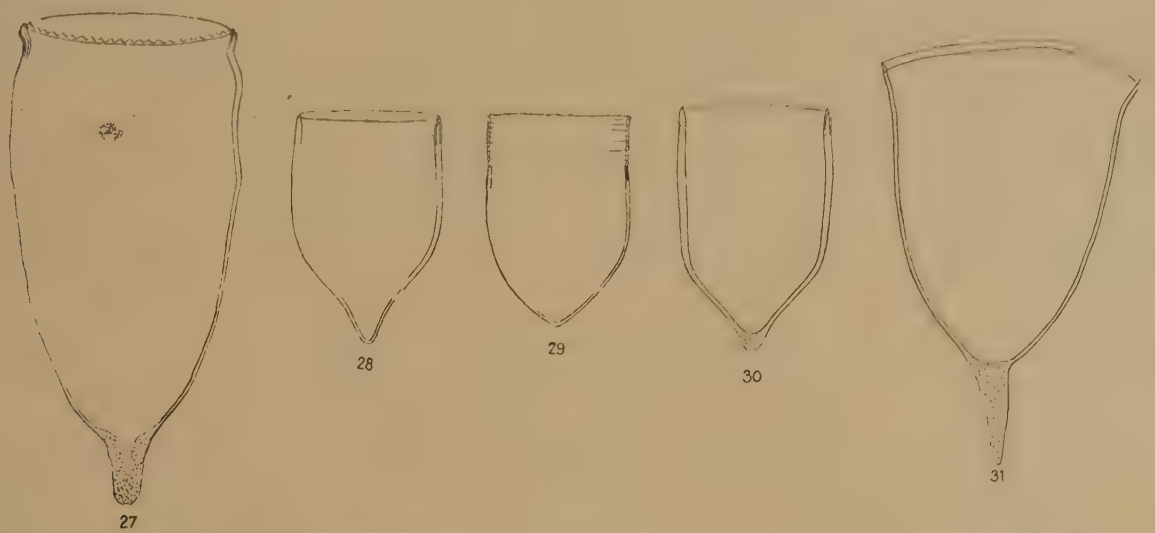


Fig. 27. *Favella serrata* (Möb.); $^{350}/_{1}$. Barcelona Harbour. Denticles of mouth only shown in front, optical longitudinal section only shown on the right side, the two lamellæ of wall as well as structure of the latter only suggested. (In like manner also in several of the following figures). Fig. 28. *Favella azorica* (Cl.); $^{350}/_{1}$. St. 160. Fig. 29. *Favella azorica, var. composita* n. var.; $^{350}/_{1}$. A thin-walled specimen (with helicoidal prolongation at the mouth). Fig. 30. *Favella azorica var. campanula* (Schmidt); $^{350}/_{1}$. St. 190. Fig. 31. *Favella adriatica* (Imhof?, Bdt.); $^{350}/_{1}$. Gibraltar. A deformed specimen from a slide, showing the relatively thin wall and the narrow and thin-walled ring at the mouth.

Otherwise known from the Azores (Sept. 1898, CLEVE), the Gulf of Siam (SCHMIDT, also recording "*Undella azorica*" from the same region), between Fuchow and the north point of Formosa ($^{18}/_{7}$ 1903, in a sample in possession of OSTENFELD) and from the Persian Gulf (HANDEL-MAZZETTI $^{16}/_{10}$ 1910). The species being so scarce in the Mediterranean and not observed there (as yet) in winter, it may be provisionally considered an allogeneous species, occurring as a summer species, most frequent in the west, especially north and south of the Balearic Isles. The loricae seem to be very light, being perhaps not easily caught with nets; the species may therefore be considerably more frequent than the relatively few records show.

3. FAVELLA ADRIATICA (Imhof?, Bdt.) (Fig. 31).

Cyttarocylis adriatica Imhof? 1886 b p. 199. C. ehrenbergi var. adriatica Brandt 1907 p. 211, pl. 41 figs. 9, 10. C. ehrenbergi f. marginata Meunier 1919 p. 8, pl. XXII fig. 3.

Sts. 84 (0 m.), 113, Tunis, 153 (many), 172 (50 m.—17 m., 200 m.—51 m.), 173, 179, Barcelona, Gibraltar.

Lorica usually widely campanulate, sometimes longer, below with rounded outlines and an offset, short and thick, frequently curved or undulated caudal prolongation, solid, or at any rate only above

hollow, occasionally with three, not very conspicuous lateral alary edges, extending up to the lower part of lorica. Wall of lorica not very thick, but as a rule distinctly double. At the mouth one, or sometimes two narrow "annuli", with a thin or mostly simple (single) wall. Structure consisting of pallid and inconspicuous, rather equal-sized meshes; the oral rim only with a "primary" reticulation.

Length of lorica proper usually 120 μ—145 μ, rarely less, down to 94 μ, not infrequently more; diameter of mouth 100 μ—113 μ, sometimes less. Wall of lorica scarcely more than 2 μ—$2^1/_2$ μ thick.

Nearly allied to the following species, but different from it in many respects, especially in the narrow and thin-walled oral rim — which may easily be overlooked — the much less thick wall of the lorica and the firmer, not rugose and relatively broader loricae.

Like the following species it is a coast form (meroplanktonic) which was sparsely present in the material of the "Thor", though occurring now and then in several specimens.

It is dobtful whether this species really is the one mentioned by Imhof. His very imperfect description certainly suggests a form, near to *Favella ehrenbergi*, as seen by Brandt; if it is different from this species — which is scarcely to be seen from Imhof's description — it may be either the present species or *F. serrata*, the mouth of which, in the Mediterranean specimens, was not always denticulate.

Seems to be a well defined species, perhaps more nearly allied to *F. serrata* than to the following species. It was first recorded from Brindisi by Imhof(?) 1886, later by Brandt (l. c., taken at Naples 1883), by Entz jun. (1909 p. p., pl. 10 fig. 9, scarcely figs. 7, 8) and Laackmann (1913 p. 28 p. p.) from the Northern Adriatic (as *Cyttarocylis ehrenbergi* var. *adriatica*). Otherwise it is known from the south-western region of the North Sea (the Flemish Sea, Meunier l. c., who also has detected resting stages of it there).

4. FAVELLA EHRENBERGI (Clap. et Lachm.).

Tintinnus ehrenbergi Claparède et Lachmann 1858 p. 203, pl. VIII figs. 6, 7. Cyttarocylis ehrenbergi Fol 1884; Daday 1887 p. 583; Entz jun. 1909 pl. 12 fig. 5, pl. 13 figs. 5, 6, 12 (conjugation).

Sts. 84 (0 m.), 85 (rather numerous), Cadiz, 96, 101, 165, 172 (50 m.—17 m.), 178, Naples (predominating), Barcelona, 226, everywhere mostly as an obvious var. helgolandica and singly or sparsely.

Lorica generally of the same shape as in the preceding species, but larger, especially longer, at the mouth, usually somewhat narrowed, maximum diameter about in the middle or a little lower, below frequently more rapidly narrowing, at the mouth without a thinwalled annulus (compare f. *claparèdei*). Wall of lorica relatively very thick, 4 μ—5 μ, less firm and often unevenly thickened (rugose); structure as in *F. serrata*, of pallid and rather thinwalled meshes of unequal size, towards the mouth generally very small. Caudal prolongation as in the preceding species with or without distinctly visible alary edges, but mostly larger, longer and thicker, generally solid and very obtuse, rarely acutish. Animalcule very large, with two large, oval macro-, and two small, rounded micronuclei (Merkle 1909 p. 160), according to Daday (1887) in f. *claparèdei* with 18 membranelles.

Length of lorica proper mostly 300 μ—400 μ, rarely but 200 μ, diameter of mouth about 100 μ, or more, caudal prolongation of very varying length.

Var. **helgolandica** Bdt. (Fig. 32 a p. 29).

Brandt 1906 p. 24, pl. 41 figs. 6, 7, 1907 p. 212.

Differs from the main species in having very conspicuous bladelike wings from the lower part of lorica to near the end of the caudal prolongation, giving the latter a triangular shape, acute below, above more or less evenly passing over into the outlines of the lorica (on one side). The cavity of the lorica may extend somewhat into the upper portion of the caudal prolongation.

In the main species this prolongation is mostly very thick and obtuse, without alary edges, or with indistinct ones, likely to be overlooked. Intermediate forms are met with occasionally.

It is this variety which, in a more or less developed form, occurs in the Mediterranean. The figures in BRANDT (l. c.) show a strikingly irregular outline, above (usually "annulated" and) funnel-shaped, below strongly and coarsely rugose; this is, however, certainly caused by shrinkage in the preserving fluids or in slides. In a natural state the lorica is of the same shape as in the main species, but easily loses this shape in glycerine or alcohol, especially if not "annulated".

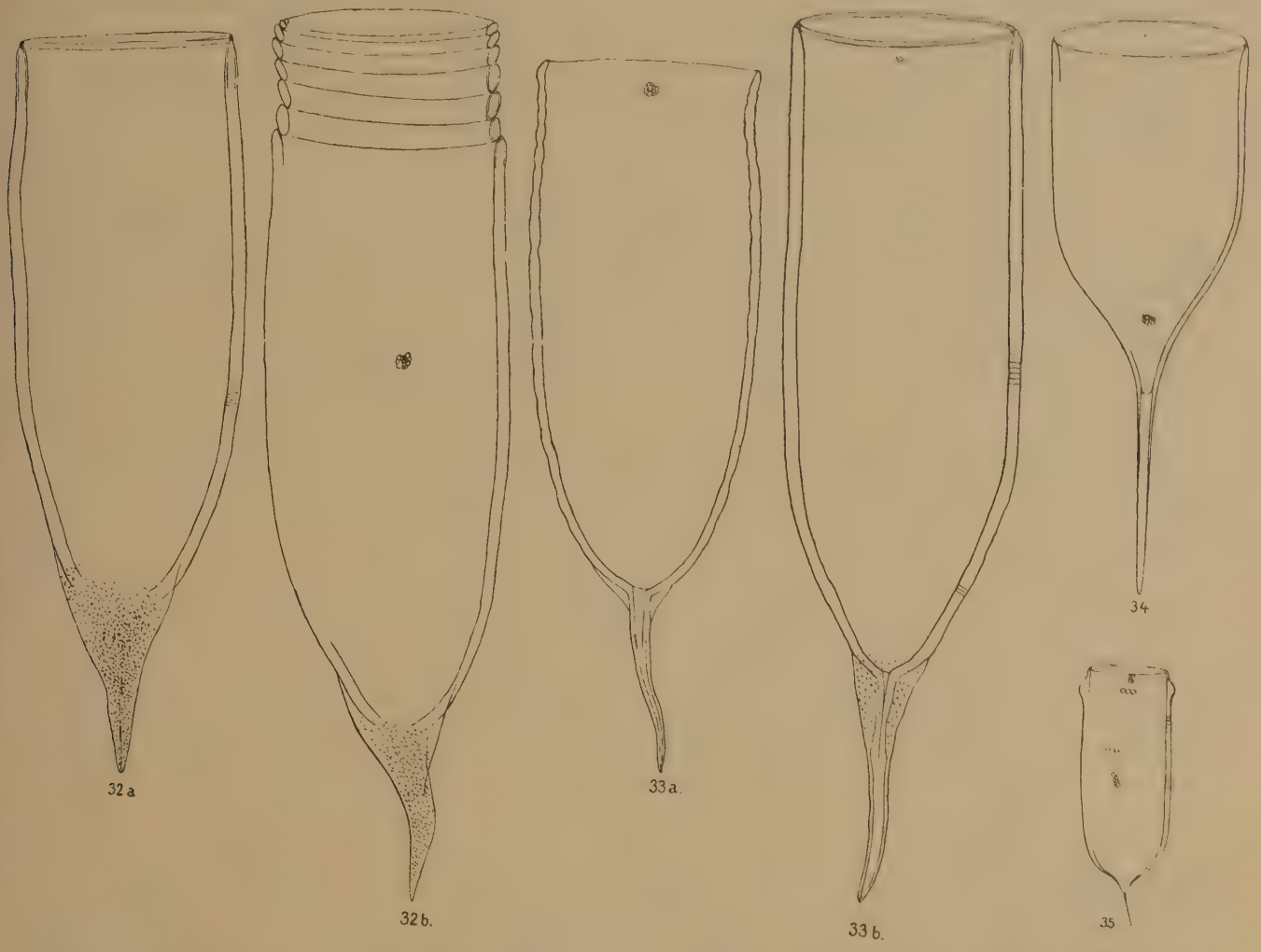


Fig. 32. *Favella ehrenbergi* (Clap. et Lachm.) *var. helgolandica* Bdt.; $^{350}/_{1}$. Naples. b: f. *claparèdei* Bdt.; a: only the lower portion of helicoidal band is finished. Fig. 33. *Favella markusovszkyi* (v. Dad.); $^{350}/_{1}$. Naples. a: suggestive of a helicoidal formation of wall, but no helicoidal line visible. b: a larger specimen with a single, narrow and thin-walled annulus at the mouth. Fig. 34. *Favella fistulicauda* n. sp.; $^{350}/_{1}$. St. 179. Fig. 35. *Favella aciculifera* n. sp.; $^{350}/_{1}$. St. 152, 950 m. wire.

The Mediterranean form seems to be smaller than the main species. Length of lorica proper usually about 250 μ, of caudal prolongation 70 μ—80 μ; diameter of mouth 95 μ—100 μ, maximum diameter (near the middle) 103 μ—107 μ, wall up to 5 μ thick.

This variety, as well as the main species, both of which apparently merge one into the other without definite limits, occurs frequently in a strikingly deviating form:

f. **claparèdei** (Dad.) Bdt. (Fig. 32 b p. 29).

Cyttarocylis claparèdei Daday 1887 p. 582, pl. 21 figs. 5, 16. C. ehrenbergi var. subannulata Jörgensen 1899 p. 37, pl. III figs. 31, 32. C. ehrenbergi var. claparèdei Brandt 1906 p. 24 pl. 41, figs. 1, 5, 8.

Lorica above with a definitely limited "annulated" portion, of the same diameter and thickness of wall as in the rest of lorica, usually with up to 6 "annuli". Otherwise as in var. *helgolandica*, or as in the main species.

This form was in the first instance figured by Claparède (1867) as *Tintinnus ehrenbergi* from the coast of Normandy, the "annulated" portion being considered a prolongation of the lorica, which no doubt is correct. From the west coast of Norway I have also seen a specimen with two such "annulated" portions, both of the usual length and 5—6 "annuli", but with a distinct border line, apparently developed at different times. This helicoidal portion presumably acts as a stiffening portion, preventing the mouth of the lorica from collapsing (cf. p. 8).

Instead of introducing a special denomination for the "annulated" form of the main species, or of var. *helgolandica*, I think the same formal name may be used; if necessary for a discrimination, one may write *F. ehrenbergi* f. *claparèdei* and *F. ehrenbergi helgolandica* f. *claparèdei*. In 1899 (Jörgensen l. c.) I believed it necessary to refer Daday's *Cyttarocylis claparèdei* as a variety to the same author's *C. markusovszkyi*, instead of to *C. ehrenbergi*. This question is still open.

This form, as belonging to var. *helgolandica*, was so frequent in the material of the "Thor" that it may perhaps prove to be the normal state of this variety, when fully developed: sts. 84, 85, Cadiz, 113, 178, Naples.

Otherwise, *F. ehrenbergi* and its varieties are known from the coasts of the North Sea, Skagerrack, Scotland and Western Norway, perhaps or probably also from the Gulf of Bothnia (Levander 1894 p. 88, pl. 3 fig. 6(?), the dimensions according to the figure and the magnification being 333 $\mu \times 67\ \mu$, not as stated 1045×238).

5. FAVELLA MARKUSOVSZKYI (Dad.) (Fig. 33 p. 29).

Cyttarocylis markusovszkyi Dad. 1887 p. 581, pl. 21 fig. 4; Entz jun. 1904 p. 125, fig. 4. Tintinnus ehrenbergi Zacharias 1906 p. 532 fig. 12.

Differs from *F. ehrenbergi* in having a long and narrow caudal prolongation, above with 3 short, but distinct alary edges, extending from the lower part of lorica to the upper of the caudal prolongation. This upper portion is coarsely granulated and apparently separated from the cavity of lorica by the inner lamella which is rounded below. The lower $^2/_3$ of the caudal prolongation is broadly acicular, with an inner broad channel and well defined, structureless, somewhat thickened side walls, of equal thickness down to the sharp point below.

Otherwise as *F. ehrenbergi*, but the lorica is firmer, and therefore not so easily deformed in glycerine; has perhaps often a somewhat thinner wall. Structure rather regular, of almost equal-sized meshes.

Length of lorica 220 μ—280 μ, of the caudal prolongation 82 μ—103 μ; diameter of mouth 95 μ—97 μ.

Brandt 1907 considers the species to be synonymous to *F. adriatica* (his *Cyttarocylis ehrenbergi* var. *adriatica*) which scarcely can be the case, already on account of the considerable difference in thickness of wall. At the mouth one or two "annuli", as in *F. adriatica*, may sometimes be seen (fig. 33 b), probably later developing into an "annulated" upper portion of the lorica. They are, however, in this species more thick-walled than in *F. adriatica*.

The figure in Entz (l. c.) shows a lorica which has shrunk and narrowed in the lower portion; it has also got longitudinal plicae. I have seen the same thing happen in specimens mounted in glycerine.

In the material of the "Thor" this species was present at Malaga Roads and at Naples (in August). Daday detected it in the latter locality where it was abundant in April. Intermediate forms to *F. ehrenbergi* var. *helgolandica* occurred at Naples; it is therefore most probable that these two forms, the variety just mentioned and the present species, ought to be united. A further question will then arise: are these

two forms to be united into a species, *F. markusovszkyi* s. l., nearly allied to, but different from the more northern species *F. ehrenbergi*, or should they be included under a common varietal name, var. *markusovszkyi* of *F. ehrenbergi?*

Also *F. markusovzkyi* occurs occasionally as an "annulated" form, analogous to f. *claparèdei* of the preceding species. As, however, DADAY describes the caudal prolongation of his *F. claparèdei* somewhat differently, it is not probable that the latter "species" is simply an "annulated" form of *F. markusovszkyi.*

ENTZ jun. found it in the Northern Adriatic. Unknown, as yet, outside the Mediterranean, if not also taken in the Malay Archipelago (CLEVE 1901 c pp. 10, 53, "*Cyttarocylis markusovszkyi?*, probably. a variety of *C. ehrenbergi*"). That he (ibid., note) considers *Undella campanula* Schmidt to be the same species, is undoubtedly due to the great dimensions stated by SCHMIDT (compare above p. 26: either the magnification is erroneously stated and the dimensions correct, or vice versa; in the first case SCHMIDT's species might perhaps be a form near to *F. adriatica.*

6. FAVELLA FISTULICAUDA n. sp. (Fig. 34 p. 29).

Lorica resembles a very short form of that in the preceding species, but is provided with a long and narrow, apparently solid caudal prolongation. It is in the upper half almost cylindrical, or slightly dilated towards the mouth, below the middle slowly narrowing and below rapidly passing into a subulate caudal prolongation which in its upper portion contains a part of the cavity of lorica. At the mouth a very low and indistinct, thin annulus is present, like that in *F. adriatica*, but lower and easily overlooked. Wall of lorica 2 μ—$2^1/_2$ μ thick; structure of fine meshes.

Length of lorica 153 μ, of caudal prolongation 111 μ, diameter of mouth 85 μ.

I only saw it in the sample from st. 179 (Aegean Sea, at the entrance to the Dardanelles).

7. FAVELLA ACICULIFERA n. sp. (Fig. 35 p. 29).

Sts. 152 (950 m. wire), 187 (945 m. wire), 189 (945 m. wire), 192 (545 m. wire), 194 (0 m., 1145 m wire), 199 (945 m. wire), 206 (1945 m. wire), everywhere but singly.

Lorica swollen below the mouth otherwise on the whole cylindrical to the lower $^1/_3$, where it is rapidly rounded off to a short, protracted point, obtuse, but carrying a fine, frequently oblique needle or bristle. The two lamellae of the wall well developed and separated down to near the protracted point where they merge into a single, thin wall. At the mouth they are also closer together, at the swollen part, however, more distant; the wall shows about the middle a secondary maximum of thickness. Meshes almost regularly hexagonal, larger and more distinctly visible on the swollen portion, smaller towards the mouth and in the lower $^2/_3$.

Length of lorica 102 μ, of the needle 13 μ; diameter of mouth 37 μ; maximum diameter 45 μ.

A singular species, not related to any of the known species. As yet otherwise unknown; there exist, however, a great many small species of Tintinnids which are only exceptionally caught by plankton nets.

POROECUS Cl.

I have been obliged provisionally to use this generic name of Cleve's (1902 b, p. 15) for the following species which as yet is little known.

POROECUS APICULATUS Cl. (Fig. 36 p. 32).

Cleve 1902 b, p. 15. Porella apiculata Cleve 1900 d, p. 973; 1901 c, p. 10; 1901 d, p. 117. Scarcely Cyttarocylis apiculata Brandt 1907 p. 203, pl. 32 figs. 3—5.

Lorica cylindrical, below rapidly narrowing into an offset, rather thick, acute, caudal prolongation. Wall not very thick, with distinctly separated lamellae, merging into each other towards the caudal pro-

longation. Structure coarse, of roundish to spherical, almost equal-sized small discs, in the middle showing a dark spot or pore; on the outlines may be seen that these discs are fixed at the outside of the wall. Mouth entire (or in CLEVE's figure somewhat irregularly wavy).

Length 115 μ, including the caudal prolongation (30 μ); diameter of mouth 30 μ. The round discs about 2 μ in diameter.

36

Fig. 36. *Poroecus apiculatus* Cl.; $^{350}/_{1}$. St. 68.

The agglutinated bodies are probably coccoliths (of Coccolithophora?); they conceal the structure of the wall, the real constitution of which I have not seen. I therefore here list the species under the name, given to it by CLEVE. BRANDT's species (l. c.) must be a different one; it may, however, prove correct that CLEVE's species also is a species of "*Cyttarocylis*" (*Favella*). In the "foreign bodies" it reminds one of the genera *Codonella* and *Codonellopsis*; no species of these genera has, however, a similar appearance.

Only one fully developed and one young(?) lorica were seen: st. 68 (Bay of Cadiz). From st. 14 (in the Southern Adriatic) I saw a single, doubtful, specimen in bad condition, perhaps belonging to this same species.

According to CLEVE known from the South Atlantic (20° S 2° E and 23° S 3° E), the Southern Indian Ocean (42° S 76° E) and from the Azores (in January). The latter record answers very well to the occurrence at st. 68 in February.

XYSTONELLA (Bdt.) Laackm. (emend.)

Lorica long, protracted, at the mouth broad and channelled, with an outer, more or less spreading, and an inner, erect, oral edge or rim, both separated by a circular groove. Caudal prolongation long and narrow, differently developed, either with a short, annular or umbellate dilation and thickening, dividing it into an upper portion, similar to the lorica proper, only narrower, and a lower, aciculate one, with a simple (single) and structureless, firm wall, — or not dilated, nor thickened, but towards the posterior end provided with a more firmly constituted portion.

Otherwise as in *Favella*.

1. XYSTONELLA TREFORTI (Dad.) Laackm. (Fig. 37 p. 33).

Laackmann 1911 p. 449. Cyttarocylis treforti Daday 1887 p. 579, pl. 21 fig. 1. C. quadridens Kofoid 1905 p. 290, pl. XXVII figs. 8—11, pl. XXVIII fig. 18.

Sts. 14, 23, 26, 28, 33, 38, 55, 68; 87, 126 (200 m.—100 m., 275 m. wire), 132 (600 m.—195 m.), 134 (75 m.—0 m.; 125 m.—75 m. numerous), 152 (250 m. wire, common; 950 m. wire), 156 (250 m. wire, 950 m. wire), 160 (100 m.—30 m.; 200 m.—100 m., several; 1000 m.—200 m.), 175 (1150 m. wire), 182 (545 m. wire), 186 (245 m. wire, 1145 m. wire; also in Salpæ), 187 (0 m., 190 m.—100 m., 945 m. wire), 189 (945 m. wire), 194 (0 m.; 1145 m. wire, rather numerous), 199 (200 m.—80 m., many specimens; 945 m. wire), 204 (945 m. wire), 206 (1945 m. wire).

Lorica very similar to that of *Xystonella acus* var. *lohmanni*, but with a different caudal prolongation; below a sharply outlined subula with a simple, structureless wall, as in *X. acus*, but above this subulate portion an umbellate dilation, usually with four acute equidistant denticles.

Lorica at the mouth usually slightly dilated, then slowly narrowing a little to about the upper $^{1}/_{4}$, then cylindrical, or mostly very gradually and slightly dilated to the same width as at the mouth. In the lower part it is rapidly narrowing, passing imperceptibly into a narrow caudal prolongation, in the middle or somewhat lower thickened into the umbellate, cup-shaped apophysis mentioned, again embracing a rather short, subulate point. Wall everywhere, save in this subulate point, with distinctly developed

and separated lamellae, very thick at the mouth and at the secondary maximum of diameter, here up to 7 μ—8 μ thick, below much narrower, at the apophysis again thicker and coarsely granulated. Structure consisting of large and rather regular hexagonal meshes, much smaller towards the mouth and in the narrowing lower part, reaching their greatest size at the secondary maximum diameter of lorica.

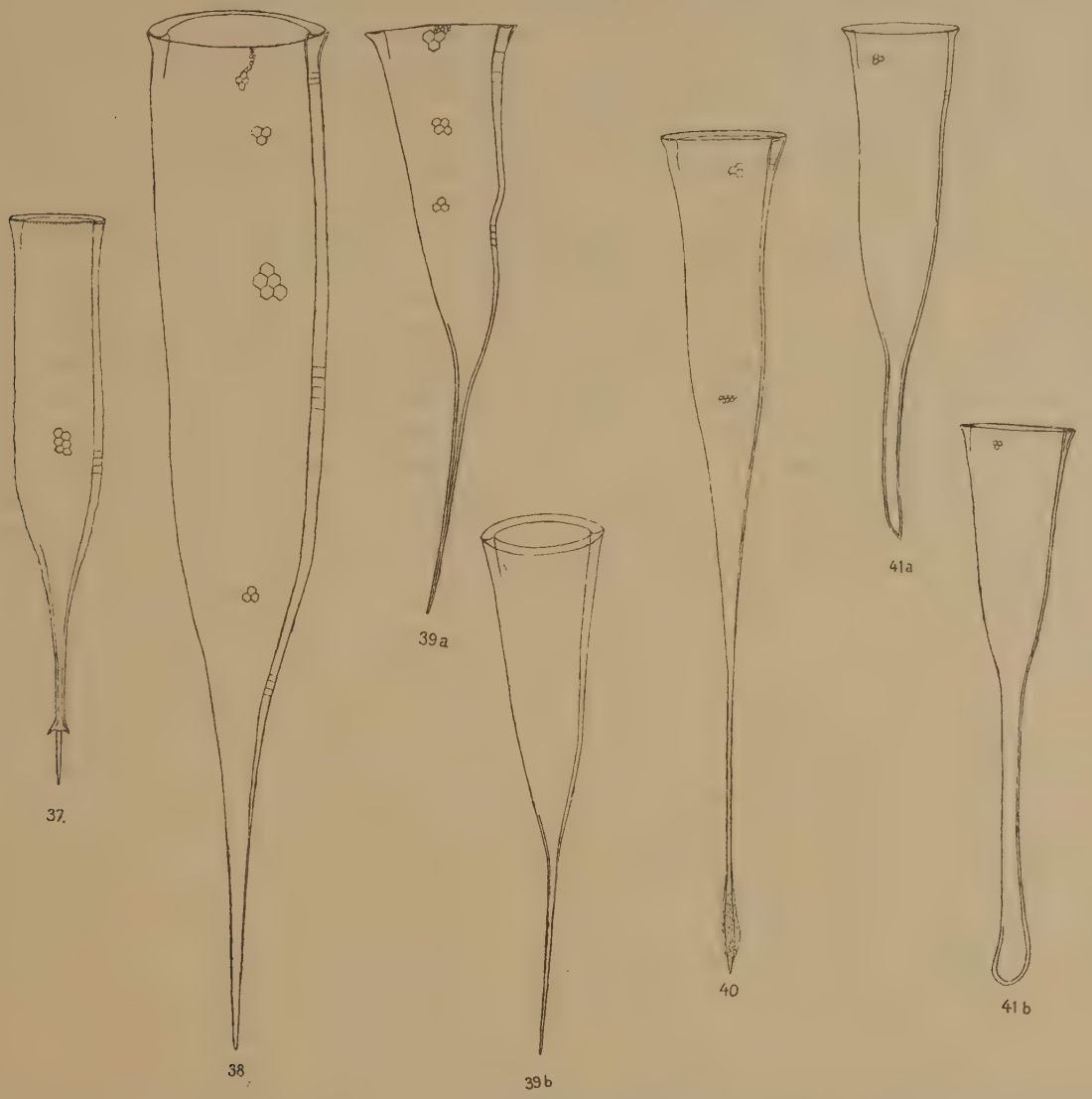


Fig 37. *Xystonella treforti* (v. Dad.) Laackm.; $^{350}/_{1}$. St. 26. Fig. 38. *Xystonella (acus* (Bdt.) *var.) lohmanni* (Bdt.); $^{350}/_{1}$. St. 234. Fig. 39. *Xystonella longicauda* (Bdt.) Laackm.; $^{350}/_{1}$. a: a somewhat deformed specimen; st. 28. b st. 145. Fig. 40. *Xystonella longicauda* (Bdt.) Laackm. *var. clavata* n. var.; $^{350}/_{1}$. St. 152, 250 m. wire. Fig. 41. *Xystonella lanceolata* (Bdt.) Laackm.; $^{350}/_{1}$. a st. 187, 945 m. wire. b *f. clavigera* n. f.; st. 182, 545 m. wire.

The mouth appears sometimes indistinctly denticulate from protruding walls of meshes, e. g. in specimens mounted in glycerine.

Total length 360 μ—470 μ, length of subula 34 μ—43 μ, outer diameter at the mouth 80 μ—90 μ, inner 62 μ—83 μ.

Was frequent in the material of the "Thor", especially in that from the summer cruise, when it was taken from off the south-western corner of Portugal all the way to Euboea. In winter it was rare

and only found singly, especially present at many stations of the Tyrrhenian Sea. In summer it was only exceptionally met with in the surface of the Mediterranean, only noted for two stations, 187 and 194, being in both localities much more plentiful at lower levels; below the surface it was taken at 14 of the 22 stations in the Mediterranean (proper), sometimes numerous (sts. 134, 194 and 199 in the Tyrrhenian Sea, and st. 152 near the coast of Barca), apparently most so between 200 m. and 100 m.

It was detected at Naples by Daday (1887) and was later reported from the Alboran Sea by Cleve (1903 b). Otherwise it is known from numerous localities in the Atlantic, from 32° S, west of the south point of Africa, to 42° N, partly in greater numbers. Also known from the Indian Ocean (Red Sea and Arabian Gulf, Mascarene Current) and from the Pacific (New Pomerania and New Zealand). All according to Ostenfeld and Schmidt 1901, Brandt 1907, Laackmann 1911 and samples of my own.

2. XYSTONELLA ACUS (Bdt.) Laackm. (Fig. 38 p. 33).

Laackmann 1911 p. 451. Cyttarocylis (Xystonella) acus Brandt 1906 p. 6, pl. 45 fig. 4, 1907 p. 244. C. treforti Cleve 1901 p. 113 p. p.(?), not C. treforti Daday (1887).

Lorica very long-protracted, widest at the mouth, then narrowing, but frequently again somewhat dilated farther down, then gradually narrowing to a more or less protracted caudal prolongation which, towards its end, is subulate, hyaline and structureless, in water much more conspicuous than the otherwise pallid lorica. Wall everywhere double, from well developed, distant lamellae, at the mouth almost cross-cut or with a broad and shallow groove; below the lamellae are gradually approaching each other and finally merge into the subula. Structure of more or less thin-walled and distinctly hexagonal meshes, especially large and conspicuous in the upper portion of lorica, mostly very small at the mouth as well as towards the subula below. The animalcule with two macro- and two micro-nuclei.

This frequent warm-water species includes in Brandt (l. c.) two varieties, var. *lohmanni* and var. *longicauda*, both well defined species. Brandt's main species seems, however, to be somewhat heterogeneous and vague, and is here only maintained in consideration of priority. According to the figure in Brandt, quoted above, the main species is a form similar to var. *lohmanni*, but decidedly shorter (360 μ long), more dilated above (diameter of mouth 71 μ), without a distinct (lower) secondary maximum of diameter, with an almost cross-cut mouth without a distinctly spreading outer, and a distinctly protruding erect inner, rim, with almost equal-sized meshes, save in the lower $^1/_3$, where they are gradually diminishing towards the subula, and at the upper border where they are very small. The thickness of wall cannot be seen on the figure 4 quoted; to judge from the figures 7 and 9 on pl. 50, by Brandt referred to the main species, it is, however, greatest at the mouth and of rather equal size in the upper $^2/_3$, without an intermediary maximum. In short, compared with var. *lohmanni*, the main species is an unprotracted form of this variety, without the intermediate (secondary) maximum of diameter, thickness of wall and magnitude of meshes, the latter only distinctly diminishing above, close to the mouth.

These chiefly negative characters also manifest themselves in the few localities recorded by Brandt: border of the Labrador Current, Gulf Stream between the Azores and the north-west coast of Spain, west of the north-west point of Scotland, between 450 m. and 650 m. below the surface at a single station in the Sargasso Sea, i. e. all rather abnormal localities for a subtropical species. The so-called main species therefore gives the immediate impression of being a badly developed form of var. *lohmanni*, which latter ought to be considered the true main species. To avoid interference with the laws of priority one might perhaps provisionally write *X.* (*acus* var.) *lohmanni*.

Var. **lohmanni** Bdt. (Fig. 38 p. 33).

Brandt 1907 p. 246, pl. 50, figs. 5, 6. Cyttarocylis denticulata var. gigantea f. edentata Fauré-Fremiet 1924 pp. 106—108 fig. 34, not C. denticulatus (Ehrb.) Fol.

Sts. 55; 79, 80 (numerous), 81 (100 m. wire), 92 (rather numerous), 98 (several), 99 (many), 111, 113, 126 (275 m. wire), 128 (100 m.—0 m.), 129 (1100 m.—0 m.), 132 (600 m.—195 m.), 134 (75 m.—0 m.,

several), 152 (250 m. wire, many; 950 m. wire), 156 (250 m. wire), 160 (100 m.—30 m.; 200 m.—100 m., several), 182 (545 m. wire), 186 (245 m. wire), 194 (1145 m. wire), 199 (200 m.—80 m., 945 m. wire), 206 (1945 m. wire), 209 (80 m.—33 m., 1000 m.—200 m., 945 m. wire, 1945 m. wire), 223 (1950 m. wire, many), 228 (1145 m. wire), 234 (200 m.—95 m., 700 m.—200 m.), 235. (As usual scarce if not otherwise mentioned).

The characters of this "variety" will be apparent from the above: extraordinarily long loricae, almost cylindrical to below the middle, sometimes slightly narrowed in the upper part, but then again slightly dilated, with greater meshes and thicker wall in the middle portion, lorica here sometimes or frequently as wide as, or slightly wider (in upper $^1/_3$) than at the mouth, where the meshes become smaller. Very small meshes are again only present close to the mouth and below, towards the subulate point. Lorica as in the "main" species not very firm and likely to lose its original shape in glycerine and certain other mounting substances; in water and glycerine it appears very pallid and may be easily overlooked, save for the conspicuous subula.

Length 330 μ—510 μ, diameter of mouth 68 μ—81 μ, of meshes up to 5 μ—6 μ, thickness of wall up to 9 μ.

According to Fauré-Fremiet (l. c.) the animalcule is conical, by a long pedicle fixed laterally in the lower part of lorica. It has an erect, almost evenly cross-cut peristome collar, surrounded outside by a multiple wreath of rather short cilia. About 24 membranelles, a long and narrow ciliary field on one side in the upper half, two oval macronuclei, one contractile vacuole near the "piston", a very deep preoral cavity and strongly refractive myoplasm in the pedicle which is supported by a couple of branches to the wall.

As seen from the list of stations this variety is very frequent in the Mediterranean, especially in the Tyrrhenian Sea, and was in summer caught all the way from off Brittany to st. 182 in the Aegean Sea, almost everywhere, however, but singly or sparsely. It is singular that it was only taken at the surface at very few stations in the Mediterranean, all in the western region in June (sts. 98, 99, 111, 113), whereas it was present almost at all stations where samples from deeper layers were taken (present at 16 of 22 stations). According to the data available it was apparently most frequent between 200 m. and 100 m. below the surface.

During the winter cruise it was rare and seemed to be replaced by less characteristic forms, so at sts. 20, Taormina, 59, 62, 66, 68. These forms were noted as *X. acus*; a revision after the experience acquired later would have been desirable; this could not, however, be undertaken.

According to the occurrence stated this "variety" apparently in part comes in from the Atlantic in spring and early summer; it seems, however, to be a true Mediterranean species, occurring chiefly in deeper layers, here and there in somewhat greater numbers.

Xystonella acus was at first reported from the Mediterranean by Brandt (l. c.) from Messina (taken by Lohmann). Laackmann (1911) reports it from New Amsterdam, Benguela and Brazil Currents.

3. XYSTONELLA LONGICAUDA (Bdt.) Laackm. (Fig. 39 p. 33).

Laackmann 1911 p. 451. Cyttarocylis (Xystonella) acus var. longicauda Brandt 1906 p. 26, pl. 50, figs. 3, 4 (1, 2), 1907 p. 246. C. inflexa Brandt 1907 p. 247, pl. 31, figs. 4, 5.

Sts. 10 (many individuals), 11, 14, 15, 28, 55, 60, 66(?), 145, 147, 152 (0 m., 250 m. wire, 950 m. wire), 154, 156 (0 m., 250 m. wire, 950 m. wire), 158, 160 (0 m.), 161, 163 (0 m., 80 m.—0 m.), 165, 179, 180, 181, 182 (545 m. wire), 183 (common), 186 (0 m., 245 m. wire, 1145 m. wire), 187 (0 m., 25 m.—0 m., 945 m. wire), 194 (0 m., 1145 m. wire), 196, 197, 198 (most numerous species), 199 (common in the surface, 30 m.—0 m., 945 m. wire), 200 (predominating), 202, 204 (0 m., 945 m. wire), 229, 231 (0 m., 1145 m. wire), singly, scarce or rather few individuals when not otherwise mentioned.

Lorica protracted, narrowly calyciform; thickness of wall greatest at the mouth, which is provided with a somewhat spreading outer rim and a more or less distinctly erect inner, separated by a broad

groove. Otherwise the lorica is almost evenly narrowing downwards, with evenly diminishing thickness of wall, at the lower $^1/_3$ more rapidly narrowing and without any definite limit passing into a relatively long and narrow caudal prolongation, $^2/_3$ to $^3/_4$, or more, of the length of lorica proper, ending in a long subula like that in the previous species, hyaline and structureless, sometimes sligthly bent or laterally deflected. Meshes with stronger walls than in the preceding species, of almost equal size in the upper half of lorica, yet abruptly diminished close to the mouth; in the lower half they gradually diminish, to very small ones towards the subula below.

The more irregular loricae, with strongly spreading outer rim of mouth (see Brandt l. c., pl. 50 fig. 4) are influenced by shrinkage in glycerine or other fluids (see also Brandt l. c. figs. 5, 6 of *X. acus var. lohmanni*). Small, indistinct denticles, at the inner, as well as at the outer, rim of mouth, may be produced in a similar way, the walls of the meshes or prismatic elements protruding a little on account of the collapsing lumina.

Total length commonly 250 μ—280 μ, of which about $^2/_5$ is the length of caudal prolongation; diameter of mouth about 57 μ (outside), with a thickness of wall about 7 μ to 8 μ.

A remarkably deviating form, or perhaps another species is

var. **clavata** n. var. (Fig. 40 p. 33).

(Cyttarocylis?) Xystonella lanceolata Brandt 1907 p. 258 p. p., pl. 42 fig. 8.

Lorica as in the main species, but in the lower, more narrowing portion strongly protracted, with a longer hyaline and subulate part, towards its end carrying an oval dilation with a broader inner channel and a thickened wall, apparently spongeous or coarsely granulated. Structure of lorica otherwise as in the main species, the wall, however, already from the upper $^1/_4$ rather thin, with correspondingly smaller meshes; in the lower half of total length the wall is exceedingly thin, with minute meshes.

Total length 350 μ, of which caudal prolongation takes 140 μ; outer diameter of mouth 55 μ, inner 43 μ.

I saw this beautiful form only from the following localities: sts. 152 (250 m. wire, 4 individuals; 950 m. wire, 1), 156 (250 m. wire, 1). It seems to have much the same relation to the present species as *Rhabdonella spiralis* var. *elongata* to its main species (see below).

As seen from the list of stations, the main species was very frequent in the Mediterranean, especially in the inner regions in summer. In contradistinction to the closely allied preceding species, it is chiefly a surface-form, occurring at several stations in greater numbers, especially in the Tyrrhenian Sea. It is certainly a true Mediterranean species, indigeneous there, being apparently independent of an immigration from the Atlantic into the western regions.

Its distribution outside the Mediterranean is as yet but imperfectly known. Brandt (l. c.) records it from the Sargasso Sea and from the vicinity of New Zealand; Laackmann (1911) found it very frequent in the samples from the German South-Pole Expedition, from $^{15}/_5$ 1903, south-east of Madagascar, in the Mascarene Current, and $^8/_8$—$^{11}/_8$, at many places in the Brazil Current, west of South-Africa, to St. Helena, $^1/_9$ 1903. It seems to be a species descending from the preceding species, presumably better adapted to life at the surface.

4. XYSTONELLA LANCEOLATA (Bdt.) Laackm. (Fig. 41 p. 33).

Laackmann 1911 p. 454, pl. XLIX fig. 7. Cyttarocylis (Xystonella) lanceolata Brandt 1906 p. 7, pl. 42 figs. 4—7 (not 8); (Cyttarocylis?) Xystonella lanceolata Brandt 1907 p. 258.

Very similar to *X. longicauda* save in the caudal prolongation (of lorica) which in the present species does not form a long and narrow subula, hyaline and structureless, but is developed into a narrow, thin-walled tube, similar to the lorica proper, save in the extreme point. In the forms described by Brandt, answering to the figs. 4—7 quoted, the latter is lanceolate, acute, wider than the rest of the

caudal prolongation, very conspicuous ("shining") in water, and showing a distinct structure of oval meshes.

Laackmann (l. c.) found the species very scarce in samples from the German South-Pole Expedition, $^{27}/_{4}$ 1903 (New Amsterdam). He corrects Brandt's description of the mouth of lorica — see Brandt (l. c.) fig. 7, with a peculiar, strongly outward curved rim of mouth, also to be seen in the preceding species in slides with glycerine (or glycerine-gelatine) and caused by shrinkage — but maintains the lack of other structure than the fine "primary" one. He mentions the accordance with the preceding species and emphasizes the lack of the large and regular "secondary" meshes, present in that species.

These latter are, however, present in my specimens (from the "Thor"). I therefore at first considered them to be a remarkable form of *X. longicauda*, deviating in another direction than the var. *clavata*, described above.

The lorica has a mouth completely agreeing with that of *X. longicauda*, and is otherwise of the same shape as in that species, but shorter, and narrowed into a more distinctly offset and much wider caudal prolongation, below either ending in a sharp point, or swollen, claviculate and very obtuse, in both cases, however, with a sharply outlined wall, in water much more conspicuous than the rest of the pallid lorica. The structure was faint and not very well visible, but essentially similar to that of *X. longicauda*, in the upper, more thick-walled portion of lorica consisting of rather large meshes, suddenly becoming much smaller near the mouth. The meshes are also small below.

If this species, *X. lanceolata*, had not been already established, I should have referred the Mediterranean forms in question to *X. longicauda* as peculiarly deviating, "monstrous" forms. The larger, oval, meshes of the dilated part below, near the pointed end, were not seen in my specimens; they answer, however, rather well to the structure of the corresponding part, near the posterior end, of *X. longicauda* var. *clavata* (see fig. 40 p. 33).

These forms only occurred singly at the following localities, always accompanied by *X. longicanda*: sts. 163 (80 m.—0 m.), 182 (545 m. wire), 187 (190 m.—100 m., 945 m. wire), 204 (0 m.). They had the appearance of being unfinished as to development of the caudal prolongation.

Total length 215 μ—234 μ, length of caudal prolongation 77 μ—110 μ, outer diameter of mouth 48 μ—51 μ.

Brandt's species was taken sparsely in the Florida Current, in the Sargasso Sea and north-east of the Azores. Laackmann found it sparsely in a sample from New Amsterdam in the Indian Ocean (German South-Pole Exp., $^{27}/_{4}$ 1903).

UNDELLA Dad.

Lorica of varying shape (in different species), oval to roundish, or cylindrical, short to moderately long, below rounded to acuminate or provided with a strongly developed caudal prolongation. No "collar" proper, nor helicoidal ("annulate") constitution of wall; the latter always with very well defined and separated lamellae, only merging into each other towards the posterior end, and usually approaching each other above, forming an erect, short tubular, oral ring, more thinwalled than the rest of lorica. Structure of lamellae and interstice generally invisible, or a more or less fine "primary" one, sometimes rather conspicuous.

The animalcule is as yet imperfectly studied, very few records being at hand, and then partly contradicting.

This genus shows connection with several of the others (with *Amphorella*, through *A. pachytoecus*, with *Favella*, through *F. azorica*, with *Epiplocylis* and *Xystonellopsis*), but is generally very easily known.

I. Subgenus UNDELLA n. subg.

No caudal prolongation of lorica, or only a rudimentary one. Structure of (outer) wall very fine or indistinct; both lamellae frequently or mostly visible also at the posterior end.

The animalcule seems to have no distinct pedicle.

1. UNDELLA CLAPARÈDEI (Entz sen.) Dad. (Fig. 42 p. 39).

Daday 1887 p. 566, pl. 19 fig. 1. Tintinnus claparèdei Entz sen. 1885 p. 202, p. 14 figs. 10, 11. Tintinnus sp.? Claparède et Lachmann 1858 p. 210, pl. 9 fig. 5 a. Undella claparèdei Brandt 1907, incl. varr. c, e, f (f. fastigata n. nom.), g (f. ovata n. nom.), excl. var. b.

Lorica oval, with its maximum diameter in the middle, above or below. Wall of least thickness below, where the lamellae approach each other; thence the thickness is gradually increasing to somewhat below the mouth, where the inner lamella bends rapidly inwards before uniting with the outer lamella at the very border of mouth. The cavity of lorica therefore shows a very characteristic urn-like shape, being somewhat constricted below the mouth.

Length 65 μ—87 μ, diameter of mouth 40 μ—45 μ, maximum diameter 65 μ—72 μ.

Is highly varying in shape and dimensions, apparently without a special geographical distribution of the different forms.

A relatively well defined form is

var. **angustior** n. nom. (Fig. 42 d).

Undella claparèdei var. d Brandt 1907 p. 364, pl. 64 figs. 9, 8, 33; var. a p. 363, pl. 64 fig. 3. Not U. subacuta Cl.

Lorica smaller and proportionately narrower than in the main species, towards the posterior end showing a slight indication of being pointed, but in the very end distinctly obtuse to rounded, with closely set lamellae.

Length 57 μ—64 μ, diameter of mouth 28 μ—30 μ, maximum diameter 46 μ—48 μ.

Brandt's fig. 3 shows a specimen somewhat obliquely, so that the pointed shape cannot be seen (compare Laackmann 1911 p. 471).

This common warm-water species was very frequent in the material of the "Thor", especially in winter, when it was taken at the great majority of stations, very frequently in greater numbers and often abundantly. It was found, indeed, from the most western station in the Bay of Cadiz — being there, at st. 69 in February, the predominating species (of Tintinnids) — all the way to st. 18 in the Bay of Aegina, most numerous in the Tyrrhenian Sea, present there everywhere and very numerous or dominating, save at a few more shallow stations near Naples. It was less numerous in the east, and especially in the most western regions, in the Alboran Sea, where it was absent at half the number of stations and otherwise scarce.

An immigration into the Mediterranean through the Straits of Gibraltar seems to take place (and succeed) in January and February, most easily in the former month — causing the occurrence at all stations along the African Coast in the Balearic — less in the latter, the species being plentiful in the Bay of Cadiz, but only noted for 3 out of 6 stations in the Alboran Sea, at two of these as var. *angustior*.

During the summer cruise the species was much scarcer and had mostly passed over into deeper layers. It is noted for the following summer stations: Sts. 81 (100 m. wire), 87, 89, 92, 95, 99, 106, 120, 126 (200 m.—100 m.; 500 m.—120 m., common; 275 m. wire, numerous), 128 (100 m.—0 m.), 129 (600 m. —0 m., 1100 m.—0 m., in both layers numerous), 132 (600 m.—195 m., common; 1090 m.—57 m., rather common), 134 (125 m.—75 m.; 200 m.—125 m., numerous; 350 m.—185 m.), 152 (250 m. wire, var. *angustior*; 950 m. wire, this variety and f. *fastigata*), 156 (250 and 950 m. wire, var. *angustior* and f. *fastigata*), 160 (1000 m.—200 m., these same forms), 170 (200 m.—85 m.; 1000 m.—195 m., f. *fastigata*, common), 175

(350 m. wire, mostly f. *fastigata*; 1150 m. wire), 182 (545 m. wire, f. *ovata*), 184 (945 m. wire, the same form, numerous), 185 (the same singly), 186 (245 m. wire, 1145 m. wire), 187 (945 m. wire), 189 (945 m. wire, numerous), 192 (545 m. wire), 194 (0 m., singly; 1145 m. wire, several), 196 (singly), 199 (200 m.—80 m.; 945 m. wire, f. *ovata*), 204 (945 m. wire), 206 (1945 m. wire, numerous), 209 (200 m.—85 m.; 1000 m.

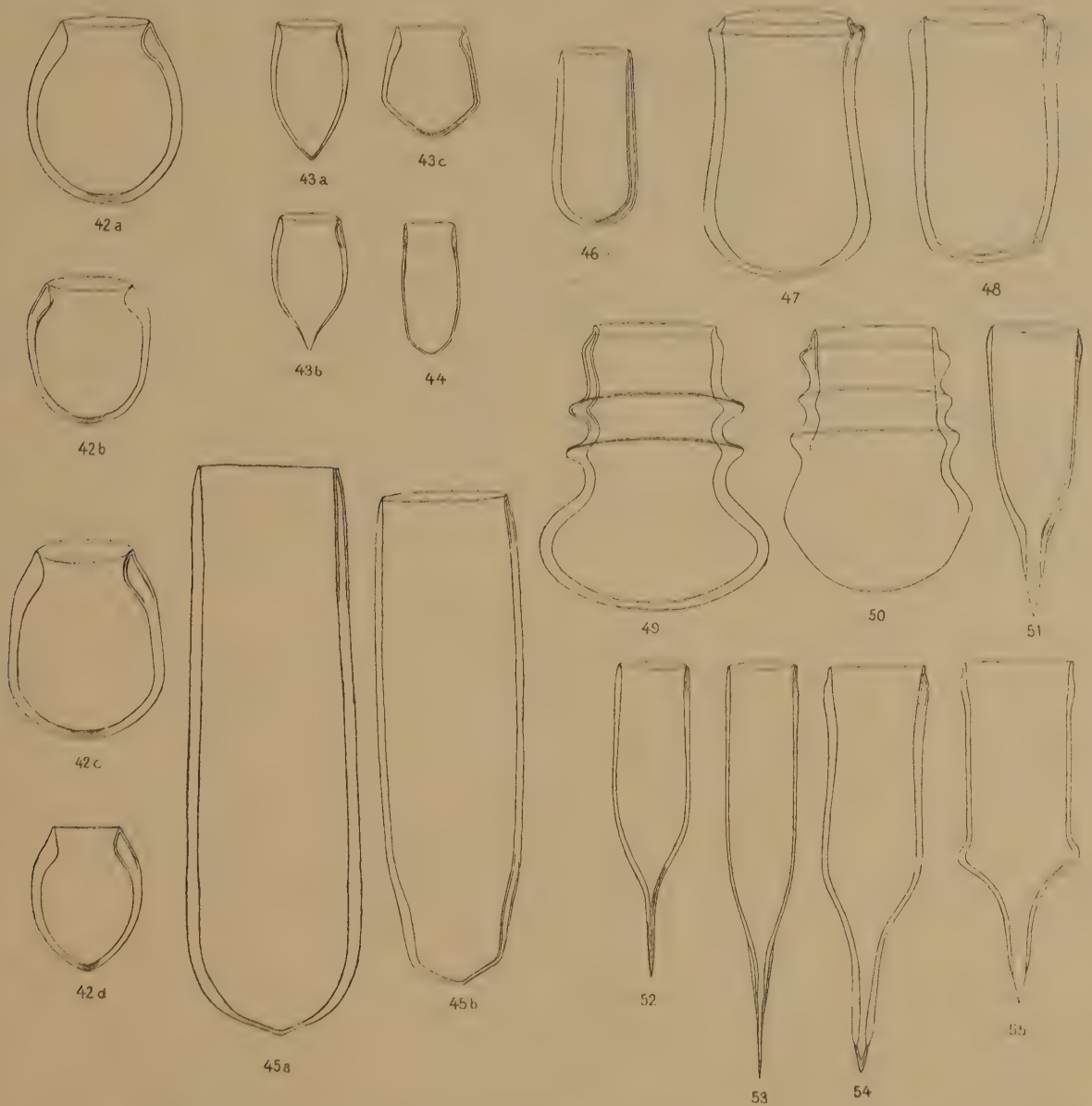


Fig. 42. *Undella claparèdei* (Entz) Dad.; $^{350}/_{1}$. a: main species, *Naupaktos*. b: *f. fastigata* n. nom.; st. 152, 950 m. wire. c: *f. ovata* n. nom.; st. 184, 945 m. wire. d: *var. angustior* n. nom.; st. 16. Fig. 43. *Undella subacuta* Cl.; $^{350}/_{1}$. a: *f. acuta* n. f.; st. 206, 1945 m. wire. b: *var. subcaudata* n. var.; st. 68. c: *var. pentagona* n. var.; st. 156, 250 m. wire. Fig. 44. *Undella clevei* n. sp.; $^{350}/_{1}$. St. 186, in Salpæ. Fig. 45. *Undella hyalina* Dad.; $^{350}/_{1}$. a: the main species; Straits of Messina, $^{6}/_{3}$ 1911. b: *f. attenuata* n. nom. St. 152, 250 m. wire. Fig. 46. *Undella dohrni* Dad., forma?; $^{350}/_{1}$. Coast of Arabia near Ras Dshibsh, Handel-Mazzetti $^{20}/_{10}$ 1910. Fig. 47. *Undella marsupialis* Bdt.; $^{350}/_{1}$. St. 23. Fig. 48. *Undella marsupialis* Bdt., *f. subangulata* n. f.; $^{350}/_{1}$. St. 152, 250 m. wire. Fig. 49. *Undella collaria* Bdt.; $^{350}/_{1}$. St. 152, 250 m. wire. Fig. 50. *Undella tricollaria* Laackm.; $^{350}/_{1}$. St. 11. The inner lamel detached below. Fig. 51. *Undella caudata* (Ostf.) Jörg.; $^{350}/_{1}$. Coast of Norway off Bergen, Decbr. 1901, 5 m.—8 m. Fig. 52. *Undella aculeata* n. nom.; $^{350}/_{1}$. St. 28. Fig. 53. *Undella aculeata f. longa* n. f.; $^{350}/_{1}$. St. 228, 1145 m. wire. Fig. 54. *Undella lohmanni* n. sp.; $^{350}/_{1}$. St. 28. Fig. 55. *Undella messinensis* Bdt.; $^{350}/_{1}$. St. 33.

—200 m., abundant and predominating; 945 m. wire, common; 1945 m. wire, rather numerous), 210, 211, 212, 213, 223 (1950 m. wire, singly), 228 (1145 m. wire, var. *angustior*, singly.

This list shows that the species is only apparently less frequent, having practically disappeared from the surface, whilst present everywhere below it. It is really absent only at a single station for deep water samples, 163. The only sample taken here from below the surface, was from 80 m.—0 m; the species being, hovewer, as a rule found in considerably deeper layers, 200 m.—100 m. or even deeper, its absence at st. 163 is not astonishing.

It is remarkable that *Undella claparèdei* is very numerous or even common in several of these samples from deeper water, especially in those from the Tyrrhenian and the Catalonian Seas, as well as from very deep water in the Sea of Marmora.

A species of so wide a distribution as the present one is as a rule rich in different forms, at least partly caused by reaction against or adaptation to varying natural conditions. This was also to be seen in the material of the "Thor". The main species (Entz l. c.) was in the inner and deeper localities wholly or partly replaced by certain other forms, f. i. f. *fastigata* n. nom. Exact investigations in this regard, of this and other species with a wide distribution, will presumably add considerably to our knowledge as to how new forms and species arise by the action of varying surrounding conditions.

The variety *angustior*, which is a form leading over towards the two next following allied species, was noted from the following stations:

11, 14, 16, 18, 58 (alone; i. e. main species absent), 60 (much more numerous than the main species), 64 (alone), 66, 68, 69, 87 (more numerous than the main species), 134 (200 m.—125 m., rare), 152 (250 m.; 950 m. wire, alone), 156 (250 m. and 950 m. wire, more numerous than the main species), 160 (1000 m.—200 m.), 186 (245 m. wire), 187 (190 m.—100 m., without the main species; 945 m. wire), 189 (945 m. wire), 190 (alone), 209 (1000 m.—200 m., 1945 m. wire), 234 (100 m.—25 m.; 700 m.—200 m., numerous and alone).

Undella claparèdei is certainly indigeneous in the Mediterranean, but is probably partly renewed every year through immigration into the Mediterranean from the Atlantic, (from late autumn? to) in January and February, disappearing almost completely from the surface in summer. It was recorded from the Mediterranean already by Entz sen. 1885, from Naples (in Salpæ), by Brandt (1907, from Messina, Lohmann), by Lohmann (1908) from Syracuse, by Entz jun. (1909) from the Northern Adriatic and by Forti (1913) from the coasts of the Sea of Marmora.

Otherwise commonly distributed in the Atlantic, from about 41° S (6° W, Cleve 1901 d) to 53° N 31° W (in April 1910) and to the south-west coast of Ireland (in April, Cleve l. c.) and the Channel. It occurs frequently in greater numbers. Also known from numerous localities in the Indian Ocean, from 33° S (97° E) northwards, and from New Pomerania in the Pacific (Brandt 1907).

2. UNDELLA SUBACUTA Cl. (p. p.) (Fig. 43 p. 39).

Cleve 1901 a, p. 923 fig. 4 a (not 4 b). Not U. claparèdei var. a ("subacuta Cleve?") Brandt 1907 p. 363, pl. 64 fig. 3, nor U. clap. var. subacuta Laackmann 1911 p. 471.

Lorica smaller than in the closely allied preceding species, more thin-walled and with a much less marked thickening of wall towards the mouth. Below it is distinctly pointed or acute, with — in var. *subcaudata* — or without — in f. *acuta* — a very short caudal prolongation.

The two lamellae of the wall close together in the lower portion of lorica or in the point below; in f. *subcaudata* the point is thin-walled, the inner lamella ending before the point.

There are several forms of loricae — belonging to Tintinnids — leading on the one hand over to the greater and more thick-walled preceding species, especially to its var. *angustior*, on the other hand to the following, which is very different from *U. claparèdei* in habitus. I have here provisionally tried to gather these forms under a common denomination, have, however, got the impression that there is more

than a single species with intermediate characters. CLEVE's species is described from his fig. 4 a; he has himself (l. c.) designated the fig. 4 b as a slenderer form of that species. As to the dimensions, there is no (essential) difference between his figures and his statements (compare LAACKMANN l. c. p. 472). Cleve has only avoided establishing another new species, answering to the "slenderer form."

A species or form, perfectly answering to CLEVE's fig. 4 a, has not yet been seen; however, to judge from the figure quoted, the lorica seems to have had a slightly oblique position, causing the maximum of diameter to be apparently somewhat displaced in a backwards direction (and the lorica to appear less acute at the posterior end?). To avoid incertitude I have given the forms observed by myself special denominations.

f. **acuta** n. forma (Fig. 43 a p. 39).

Lorica rather narrowly oval, the maximum diameter in the middle or slightly above (in CLEVE's fig. 4 a below the middle). The inner lamella visible to the posterior, distinctly acute, end of lorica.

Length 57 μ—60 μ, diameter of mouth 28 μ—32 μ, maximum diameter 33 μ—42 μ, thickness of wall (above) up to 3 μ—4 μ.

Sts. 11; 152 (950 m. wire, several), 156 (250 and 950 m. wire), 163 (80 m.—0 m.), 182 (545 m. wire), 187 (190 m.—100 m.), 189 (945 m. wire), 206 (1945 m. wire), 223 (1950 m. wire); everywhere, except at st. 152, singly.

var. **subcaudata** n. var. (Fig. 43 b p. 39).

Very similar to the preceding form, chiefly differing from it only in having a somewhat protracted, narrowly conical, acute lower end, thin-walled, because of the inner lamella not following to the extreme point, where the two lamellae are replaced by a single, thin wall.

Length 60 μ—62 μ, diameter of mouth 30 μ, maximum diameter 32 μ—38 μ.

Sts. 28, 29, 33, 39, 68; 152 (250 m. and 950 m. wire), 156 (250 m. wire).

var. **pentagona** n. var. (Fig. 43 c p. 39).

Lorica mostly more or less distinctly pentagonal (in optical view), the greatest diameter below the middle. Thickness of wall very small, its maximum below the mouth distinctly visible, but not very conspicuous; the two lamellae apparently merging into another at or below maximum of diameter (of lorica). In optical view the lower end is obtuse-angled.

Length 51 μ—53 μ, diameter of mouth 29 μ—32 μ, maximum diameter 39 μ—42 μ.

Considerably similar to CLEVE's fig. 4 a, but generally greater and proportionately broader.

Sts. 152 (250 m. wire), 156 (250 m. wire), 182 (545 m. wire), 189 (945 m. wire), 192 (545 m. wire), everywhere singly.

This form makes the impression of being a separate species. It is — as seen from the list of stations — only taken in deeper layers of the Eastern Mediterranean, where so many species of *Ceratia* and *Dinophysiaceæ* of markedly subtropical (or even tropical?) character are found occurring singly. I have also seen it from the Indian Ocean (about 12° N 58° E, $^{7}/_{4}$ 1912, S/S Scharnhorst, capt. TEXTOR) and from the south-eastern corner of Arabia ($^{28}/_{10}$ 1910, HANDEL-MAZZETTI).

The variety *subcaudata* is the most easily known of these forms, on account of its protracted, thin-walled, posterior end, and might very well be considered a separate species. I have, however, the impression that it may not always be safely distinguished from the forma *acuta*, which again is closely allied to *Undella claparèdei* var. *angustior*.

3. UNDELLA CLEVEI n. sp. (Fig. 44 p. 39).

Undella subacuta forma Cleve 1900 p. 923 fig. 4 b. *U. Dohrni?* DADAY 1887 p. 566, pl. 18 fig. 22.

Sts. 14, 26, 28, 29, 33; 152 (250 m. wire), 182 (545 m. wire), 186 (in Salpæ), 187 (945 m. wire), 206 (1945 m. wire), 209 (80 m.—33 m.), everywhere singly.

Lorica almost cylindrical, generally slightly wider at or below the middle, below short and broadly conical and slightly acute. Wall rather thin, below the mouth slightly or imperceptibly thickened, the two lamellae distinct and distinctly separated down to near the end, where they merge into each other. The mouth sometimes slightly dilated.

Length 55 μ—71 μ, diameter of mouth 23 μ—31 μ, maximum diameter 25 μ—32 μ.

Is much more closely allied to *Undella hyalina* than to *U. claparèdei.*

This species seems to be rather widely distributed in deeper layers of the Mediterranean in summer. On account of its narrow loricæ it presumably slips easily through the net.

It answers in dimensions to *Undella dohrni* Daday, save in diameter of mouth, this being stated by Daday as only 14 μ. It was, however, remarkably varying in shape (and thickness of wall); therefore, it is not quite impossible that Daday's species may be a similar form. Brandt considers it to be a form of *Undella claparèdei,* which seems to me very improbable. (See below p. 43).

4. UNDELLA HYALINA Dad. (Fig. 45 p. 39).

Daday 1887 p. 564, pl. 18 fig. 17; Brandt 1907 (incl. varr. a, b, excl. var. c).

Sts. 10, 11, 12, 14, 15, 16, Naupaktos (many), 18, 20, Taormina, Naples, 23, 24, 25 (several), 26, 28 (several), 29, 31, 33, 38, 39, 40, 42, Galita, 45, 46, 50, 53, 55, 57, 59, 60, 64, 66, 68, 69; 92, 95, 96, 98, 126 (500 m.—120 m., 275 m. wire), 128 (100 m.—0 m.), 129 (80 m.—0 m., 1100 m.—0 m.), 132 (600 m.—195 m.), 134 (75 m.—0 m.), 125 m.—75 m., 200 m.—125 m., 350 m.—185 m.), 152 (250 m. and 950 m. wire), 156 (250 and 950 m. wire), 160 (30 m.—0 m., 100 m.—30 m., 200 m.—100 m., 1000 m.—200 m.), 163 (80 m.—0 m.), 185, 189 (945 m. wire), 192 (545 m. wire), 194 (0 m., 1145 m. wire), 199 (30 m.—0 m., 945 m. wire), 203, 204 (945 m. wire), 206 (1945 m. wire), 209 (80 m.—33 m., 1000 m.—200 m., 1945 m. wire), 216, 217, 220, 221, 223 (1950 m. wire, many), 224, 225, 228 (0 m., 1145 m. wire), 229, 231 (0 m., 1145 m. wire), 234 (25 m.—0 m., 700 m.—200 m.), singly or sparse, if not otherwise mentioned.

Lorica large, almost cylindrical, sometimes slightly narrowing towards the mouth, usually narrowing slowly in the lower $^1/_5$, then abruptly, to a rounded or low conical and very obtuse end. Frequently the lorica is almost exactly cylindrical down to the posterior end, which is short and broadly conical or rounded. The two lamellae of the wall well developed (thickened) and well separated, at the mouth approaching each other, below more distant, at the posterior end merging into a single, thin wall, or in contact with each other, or slightly separated. Wall of lorica accordingly thinnest towards the mouth and at the posterior end, thickest about at the lower $^1/_6$.

Length 180 μ—255 μ, diameter of mouth about 60 μ. Sometimes considerably shorter individuals are found (sts. 231, 234, outside the Mediterranean); the diameter is, however, only slightly varying.

The animalcule is fixed at the posterior end of lorica by the attenuated end of the body, or — as also in *U. claparèdei* — by 2 or 3 short branches (Daday 1887, Entz jun. 1909). The peristome collar has rounded lobes (see Daday l. c.). Two oval macro- and two rounded micronuclei (Daday l. c., Entz jun. l. c.).

The most common form, also in the Mediterranean is

f. attenuata n. f. (Fig. 45 b p. 39).

U. hyaline var. a Brandt 1907 p. 359, pl. 63, figs. 1—3, pl. 64 fig. 17.

This is the form with the gradual conical narrowing in the lower part of lorica.

Brandt considers as the main species the long and almost completely cylindrical form (fig. 45 a), founded on Daday's figure quoted, which, however, is scarcely exact enough to be used for identification of special forms. In this case the great length, stated by Daday to from 220 μ up to 240 μ, decides the question; the commoner form, *attenuata,* being generally considerably shorter. This greater form I have noted from sts. 16; 132, 185, 189, 192, i. e. from the Eastern Mediterranean and the Tyrrhenian Sea.

Undella hyalina was very frequent in the Mediterranean. In winter it was present almost everywhere along the route, as a rule sparsely, in a few places nearer the coast more numerous (sts. 28, Naupaktos, off Naples). In summer it was noted from 18 of the 22 stations where deep-water samples were taken, from somewhat less than 100 m. to more than 200 m.; at the surface it was absent everywhere east of Sardinia, save at st. 185, whilst it was frequently met with also in the upper layers of the most western regions, the western Balearic and the Alboran Sea, though always more sparsely than in deeper layers. At st. 223 it was rather numerous at a greater depth (1950 m. wire), a fact, suggestive of an emigration from the Mediterranean through the Straits of Gibraltar into the Atlantic. These "wire-samples" may, however, in regard to microplankton easily lead to false conclusions, having caught material also during the hauling in of the net.

This species is certainly indigeneous in the Mediterranean, but is also partly renewed every year by immigration into the Mediterranean from the Atlantic, in winter (January and February) causing an increase in numbers in the western regions, in June apparently failing, in September again succeeding. Very probably a successful invasion takes place from autumn to late winter; I have seen f. *attenuata* from the Straits of Gibraltar in Decbr. 1908 (S/S "Sevilla", capt. J. Röd).

It was first recorded from the Mediterranean by Daday 1887, as a new species (from Naples). Later it was mentioned by Brandt 1907 from Messina (taken by Lohmann), by Entz jun. 1904 from the Northern Adriatic, and by Lohmann 1908 from Syracuse.

Otherwise known from the Atlantic, from 30° S 9° W (the "Fram", July 1911) to about 39° N in the Florida Current (Brandt l. c.) and to the Azores — where present January to March, as well as October and November (Cleve 1901 d) — as well as to the west coast of Portugal. Generally only scarce, more numerous in the Sargasso Sea (Brandt l. c.). Also taken at many places in the Indian Ocean between South Africa and Australia (according to Laackmann 1911 and to samples in my possession). In the Pacific taken at the Tonga Isles (Brandt 1907).

5. UNDELLA DOHRNI Dad.

Daday 1887 p. 566, pl. 18 fig. 22.

This species, taken at Naples by Daday in few specimens in March, was not with certainty seen by myself in the material of the "Thor". According to Daday's description and figure it should answer to *U. clevei*, only being much more narrowed above, to 14 μ diameter of mouth, and correspondingly bulging below.

I have seen another species (east coast of Arabia, Handel-Mazzetti, $^{20}/_{10}$ 1910), similar to a very small specimen of *Undella hyalina*, below somewhat dilated and rounded, which also in part answers to *U. dohrni*, but has a much wider mouth: length 74 μ, diameter of mouth 31 μ, maximum diameter 36 μ (fig. 46). It is considerably more thick-walled than *U. clevei*. This is probably the same form which Brandt (1907 p. 359) lists as *U. hyalina* var. c from the North Equatorial Current ("Pl. 66"), if there might be some mistake as to the length stated (155 μ). No magnification is quoted for the corresponding figure (pl. 64 fig. 19); if we suppose it to be 550 — which is used for many other figures of the same plate, in stead of 225, used in figs. 16—18 — the dimensions are 62 μ (length), 23 μ (diameter of mouth), 28 μ (maximum diameter), answering tolerably well to those in Daday (63 μ, 14 μ, 36 μ), only the mouth is again much too wide.

Ostenfeld and Schmidt (1901 p. 182) record Daday's species — as *U. claparèdei* var. *dohrni* — from the Gulf of Arabia, without figure or description.

6. UNDELLA MARSUPIALIS Bdt. (Figs. 47, 48 p. 39).

Brandt 1906 p. 8, pl. 63 figs. 7, 8, pl. 64 fig. 20.

Sts. 14, 20, 23, 24, 25, 26, 28, 29, 31, 33, 36, 38, 39, 40, 42, 55, 59, 60, 68, 69; 81 (100 m. wire), 87, 89, 126 (200 m.—100 m., common; 500 m.—120 m.; 275 m. wire, common), 128 (100 m.—0 m.), 129

(600 m.—0 m.; 1100 m.—0 m., many), 132 (600 m.—195 m., 1090 m.—57 m.), 134 (75 m.—0 m., 125 m.—75 m.), 152 (250 m. wire, many; 950 m. wire, many), 153, 156 (250 m. wire, 950 m. wire), 160 (200 m.—100 m., 1000 m.—200 m.), 175 (350 m. wire, 1150 m. wire), 179, 182 (545 m. wire), 186 (245 m. wire, 1145 m. wire), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), 192 (0 m., 545 m. wire), 194 (0 m.; 1145 m. wire, many), 195, 199 (200—80 m., many; 945 m. wire), 200, 202, 204 (0 m., 945 m. wire), 206 (1945 m. wire), 209 (200 m.—85 m., 1000 m.—200 m., 945 m. wire; 1945 m. wire, many), 210, 223 (1950 m. wire), 234 (100 m.—25 m., 700 m.—200 m.). Scarce, if not otherwise mentioned.

Lorica short and wide, in side view almost rectangular, slightly swollen just below the mouth, then of almost equal width to the middle. In the lower half, it is either somewhat widened towards the abruptly and broadly rounded end, or of almost equal width, or in the lower $^1/_3$ narrowing by convex lateral outlines towards a slightly polygonal lowest portion, showing (on the optical section) more or less marked lateral corners. The two lamellae of the wall strongly developed (thickened) and distant, closer at the lower end and particularly at the mouth, where both lamellae are in contact or fused, forming a proportionately thin, obliquely upward an inward directed upper rim, protected and supported by a lower outer one, more or less distinctly protruding on the swollen part mentioned.

Length 102 μ—128 μ, diameter of mouth 51 μ—54 μ, upper maximum diameter 68 μ—71 μ, lower 64 μ—71 μ, maximum thickness of wall (at the swollen part above) about 7 μ.

The first above quoted figure in Brandt, pl. 63 fig. 7, is according to my own experience, an uncommon form — it is much wider below than above — and should therefore be avoided as representative of the main species, whereas his fig. 8 shows a common form. This may be taken to represent the main species, no other being chosen before.

This main species, showing a secondary maximum of diameter more or less far below the middle, was in the material of the "Thor" present at the following stations: 153, 175 (350 m. wire, 1150 m. wire), 179, 192 (0 m., 545 m. wire), 194 (0 m., 1145 m. wire), 199 (200 m.—80 m.), 204 (0 m.), 206 (1945 m. wire), 209 (1100 m.—200 m., 945 m. wire; 1945 m. wire, many), 210, 234 (100 m.—25 m., 700 m.—200 m.), always singly or very sparsely, save at st. 209, 1945 m. wire. Also present in winter.

The most frequent form taken during the summer cruise, and the only one occurring in greater numbers, was the following,

f. **subangulata** n. f. (Fig. 48 p. 39).

Differs from the main species in the absence of a marked secondary maximum of diameter below, and in showing more or less distinctly angular corners between the lateral and the posterior outlines.

Undella marsupialis is otherwise rather constant; frequently, however, particularly in summer samples from deeper water, a form with only a faintly pronounced or lacking lower maximum of diameter is met with, similar to f. *subangulata*, but without the angular corners below. This form, f. *subcylindrica* n. f., passes, however, apparently without a definite limit over into the form mentioned.

This species was very frequent in the Mediterranean, also in winter, though in that season always very scarce. In summer it was taken all the way from the north-western coast of Portugal as far as into the Sea of Marmora, in the Mediterranean, however, almost exclusively in deeper water, only at 8 stations — 7 of them in the Western Mediterranean — at the surface, and at all of these singly or very scarce, whilst below it was not seldom rather plentiful. It is also noteworthy that is was the main species which was generally met with in the surface, whereas this same form usually or mostly was lacking in deeper layers, or, at any rate much rarer there than f. *subangulata* (and f. *subcylindrica*). Forms intermediate between the main species and the other two mentioned, were not rare.

All this seems to me to suggest that the main species in the Mediterranean gives rise to the two deviating forms mentioned, particularly where the latter are present in greater numbers.

Direct indications of an immigration from the Atlantic into the Mediterranean are lacking; the distribution in winter might, however, be suggestive of such an immigration in late autumn. I have seen

the species in a sample from the Straits of Gibraltar in Decbr. 1908 (the Sevilla, capt. J. Röd). It certainly is, however, a true Mediterranean species, though only in winter frequent at the surface; in summer it is generally present everywhere at some deeper level — noted for 19 out of 22 stations — partly abundant, particularly in the Tyrrhenian Sea.

Was first reported from the Mediterranean by Brandt 1907 (Messina, taken by Lohmann), later by Lohmann 1908 from Syracuse, and by Entz jun. 1909 from Naples (in December).

Otherwise the species is as yet only known from rather few localities: Off the south-western coast of Africa, in the Brazil Current (Laackmann 1911), frequent and partly present in somewhat greater numbers in the North Equatorial Current, west of Africa, and sporadically, as well as very scarce, in the Sargasso Sea and the Gulf Stream, as far as west of the Straits of Gibraltar (in October, Brandt l. c.). I have also seen it in a sample from the Pacific (off the coast of Mexico, 21° N 106° 25′ W, the Alden, capt. Kars, $^{14}/_{8}$ 1910).

These, relatively few, localities, compared with the wide distribution in the Mediterranean, seem to indicate that the species properly belongs to deeper layers. The exact depth of these in the Mediterranean cannot easily be determined; it seems, however, generally to answer to the depth where the density of water grows more constant (σ_t about 28.9 to 29.0 for the stations where the species was occurring in greater numbers). This may, however, be interpreted in two different ways; the species may require this density, to be able to keep floating, or the dead individuals (or loricæ), may sink into and gather in this layer. Loricæ with remains of the animalcule were sometimes, it is true, found at a considerable depth (f. i. at st. 223, 1950 m. wire); the animalcule may, however, have been dead. Besides, empty loricæ are always greatly in the majority.

Nevertheless, both the present and several, or even many, other species of Tintinnids certainly (when alive) chiefly belong to deeper layers, at any rate in the Mediterranean in summer.

7. UNDELLA COLLARIA Bdt. (Fig. 49 p. 39).

Brandt 1906 p. 8, pl. 63 fig. 12, pl. 64 fig. 21; 1907 p. 361 (incl. var. a).

Sts. 152 (250 and 950 m. wire), 156 (950 m. wire), 160 (200 m.—100 m.), 182 (545 m. wire), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), always singly or very sparse.

Lorica similar to one of the preceding species, strongly swollen below; it is, however, in the middle and above provided with two, strongly pronounced and very prominent annular dilations.

Length 122 μ—130 μ, diameter of mouth 55 μ, maximum diameter (below) 96 μ—100 μ.

In this and the closely allied following species there are four, more or less strongly pronounced annular widenings, of which in the present species the two median, more approximated ones, are acutely prominent. The upper one is in this species obsolete and situated near the mouth, as in *U. marsupialis*; its outer (and upper) border is showing as a faint or indistinct line parallel to the orificial rim, 9 μ—10 μ below the latter. The distance from the same to the next widening of the lorica, an acutely projecting annular rib, is about 25 μ, maximum diameter of the latter = 72 μ—77 μ, the distance farther on to the next annular rib, similar to the preceding, about 21 μ, diameter of the rib = 77 μ—83 μ, i. e. slightly greater than the preceding. The fourth annular widening is much broader (higher) and rounded off; its maximum diameter is 96 μ—100 μ, and is situated at a distance of 45 μ—47 μ below the third dilation. Thickness of wall up to 7 μ, only less at the mouth and at the broadly rounded posterior end.

This beautiful species seems not to have been observed before in the Mediterranean.

In the material of the "Thor" it was only noted for deeper layers in the Eastern Mediterranean, 200 m.—100 m., perhaps also deeper.

Otherwise only known from the Sargasso Sea (at many places, Brandt l. c.). Allied forms or species are rather widely distributed in the southern Atlantic, between South-Africa and South-America (the "Fram" 1911).

8. UNDELLA TRICOLLARIA Laackm. (Fig. 50 p. 39).

Laackmann 1911 p. 470, pl. XLIX figs. 18, 19.

Very near to the preceding species, but much les swollen below, and with a more pronounced annular and somewhat acutely projecting widening below the mouth. Also, the distance between the first and the second annular widenings is but slightly greater than between the two following.

Also in this species forms with les pronounced or obsolete upper (1st) or lower (4th) annular widenings are met with; they were, however, not observed in the Mediterranean.

Length 118 μ, diameter of mouth 55 μ, maximum diameter (at the 4th widening) 84 μ. Diameter of 1st annular widening 65 μ, situated at a distance of 9 μ—10 μ below the mouth, diameter of 2d widening 67 μ, at a further distance of 19 μ, diameter of 3d widening 75 μ, distance 17 μ; the 4th widening (at its maximum) 32 μ farther down, usually much less acute or sometimes even lacking (see LAACKMANN l. c. fig. 19).

I saw this species only in the sample from st. 11 in the Jonian Sea in Decbr. Otherwise only known from the Brazil Current, west of South Africa (German South-Pole Exp., 18th—22d of Aug. 1903, LAACKMANN l. c.).

II. Subgenus PARUNDELLA n. subg.

Loricæ more or less elongated, with a well developed, simple caudal prolongation. Structure of (outer) wall generally very well visible, frequently rather conspicuous, though only a "primary" simple one. Lamellae generally rather approximated, though as a rule distinctly separated, save at the posterior end where they are merging into each other, forming a single-walled lower and generally firmer part of the caudal prolongation.

Is nearly allied to the genus *Xystonellopsis* (se below).

9. UNDELLA CAUDATA (Ostf.) Jörg. (Fig. 51 p. 39).

Jörgensen 1900 p. 95. Tintinnus caudatus Ostenfeld 1899 b, p. 438 fig. 2 e (p. 437). Undella pellucida Jörgensen 1899 p. 41, pl. I figs. 7, 8. U. lachmanni Brandt 1907 p. 367, pl. 64 fig. 26, incl. var. a, p. 368, pl. 64 figs. 25, 27 (not var. b caudata).

Lorica in the upper half cylindrical, frequently slightly dilated somewhat below the mouth, in the middle sometimes slightly narrowed, but then again dilated to a somewhat greater width than in the upper half; below it is narrowing more rapidly, by convex lateral outlines, merging imperceptibly into a rather short, narrowly conical and acute caudal prolongation, thin-walled and with a rather broad, conical cavity. Both lamellae of the wall well developed and distinctly separated for about the upper half of the caudal prolongation, then merged into a single thin wall. Thickness of wall, or distance of lamellæ, greatest above, sligthly below the mouth, as well as below, about where the lorica proper passes over into the caudal prolongation. Alary ribs or plicæ from the upper portion of this prolongation up to the lower one of lorica, may be present.

Total length usually 110 μ—125 μ, exceptionally down to 90 μ, or up to 179 μ, length of caudal prolongation usually 34 μ—42 μ; diameter of mouth usually about 40 μ, up to 46 μ. Length of the conical, single-walled, lower part of caudal prolongation usually 17 μ—20 μ.

In my quoted paper of 1899 the diameter of mouth is erroneously stated to be 65 μ and 62 μ (in the two cases mentioned there), which may be a printer's error (for 45 μ and 42 μ).

Only a very fine primary structure.

This species is closely allied to the following; nevertheless it is so different from it in the constitution of the lower (posterior) part of the lorica that they should be considered separate species, at least provisionally. In this subgenus there are several closely allied species, needing further examination before the true limits can be drawn.

Is a northern Atlantic, cold-temperated species, distributed from 38° N off the coast of North America (the "Texas", April 1910, capt. PEDERSEN) northwards to Iceland (OSTENFELD 1899 and 1900) and to Lofoten (JØRGENSEN 1905), to the south perhaps as far as the Azores (CLEVE 1901 d and 1902 b). More southerly situated localities (CLEVE l. c., LAACKMANN 1911) require further confirmation.

In the material of the "Thor" I saw this species only in stomachs of Salpæ from st. 80 (Bay of Biscay). (Length of lorica varying). It is not known from the Mediterranean, but has been confounded with the following warm-water species.

10. UNDELLA ACULEATA n. sp. (Fig. 52 p. 39).

U. lachmanni var. b caudata Brandt 1907 p. 368, p. 64 figs. 24, 24 a, 14; Laackmann 1911 p. 474. Not Tintinnus caudatus Ostf.

Sts. 28, 55, 59, 60, 68; 81 (100 m. wire), 132 (600 m.—195 m.), 134 (125 m.—75 m., 200 m.—125 m.), 152 (950 m. wire), 182 (545 m. wire), 194 (0 m., 1145 m. wire), 199 (200 m.—80 m.), 206 (1945 m. wire), 223 (1950 m. wire) 228 (1145 m. wire), 234 (100 m.—25 m., 200 m.—95 m.), always singly or very few individuals.

Very near to the preceding species; lorica, however, with a longer and narrower caudal prolongation, in the lower part subulate or needleshaped, with a thickened, single and homogeneous wall and a narrow inner cavity or channel, or sometimes apparently wholly or partly solid. Lorica almost cylindrical as far as or to somewhat below the middle, then conically protracted in a downward direction, with almost perfectly straight or somewhat convex lateral outlines passing over into a rather offset, narrow caudal prolongation. Thickness of wall generally somewhat less than in the preceding species, only slightly greater above and below. The two lamellæ of the wall everywhere distinctly separated down to the narrow caudal prolongation, where they merge into each other about in the middle. This lower half of the caudal prolongation is very firm in consistence and more conspicuous in water than the rest of the lorica, recalling the corresponding lower spine-like part in *Xystonella acus*. The channel-like cavity inside generally distinct in the upper part of the subulate end, frequently also visible to the very end, but seems sometimes to be lacking. Alary edges or ribs from the upper portion of caudal prolongation, up to the lower part of lorica, may be present, but are generally narrow and inconspicuous.

Total length 130 μ—187 μ (f. *longa*), of lorica proper 100 μ—128 μ; diameter of mouth 31 μ—40 μ. Length of subulate part below up to 35 μ or sometimes more; thickness of wall about 2 μ only.

F. **longa** n. f. (Fig. 53) has a more protracted lower part of lorica, and a longer caudal prolongation than usual.

Sts. 228 (1145 m. wire), 234 (700 m.—200 m.), singly.

Undella aculeata is rare and scarce in the Mediterranean, during the winter cruise only met with in the Alboran Sea and near Naples, in summer sporadically in deeper layers, again particularly between 100 m. and 200 m., or deeper, all the way from the Alboran Sea as far as to Euboea, but only at a single station present at the surface (at st. 194 where many species, otherwise only noted for deeper layers, were met with at surface, probably on account of the submarine ridge in the Straits of Messina).

Otherwise it is as yet only known with certainty from scattered localities in the Atlantic, from about $28^1/_2°$ S in the Benguela Current, west of southern South-Africa (German South-Pole Exp., $^{11}/_8$ 1903, see LAACKMANN l. c.), to the meeting of the Florida and the Labrador Currents, far south-east of Nova Scotia (BRANDT l. c.). I have seen a species or form very similar to the f. *longa* from the Indian Ocean (43° S 99° E, S/S Akershus, March 1911, capt. MARTIN).

We should probably also include here the *Undella caudata*, by CLEVE (1901 c) reported from the southern Indian Ocean, and by OSTENFELD (1907) from the Benguela Current, as well as most of the localities south of the Azores reported by CLEVE (1901 d and 1902 b).

"*Undella lachmanni*" is in the first instance recorded for the Mediterranean by LOHMANN (1903 and 1908) from Syracuse, and later by ENTZ jun. (1909) from Naples, in both instances without figure or description.

In the material of the "Thor" there is a faint indication of immigration into the Mediterranean from the Atlantic in February (and perhaps in May (?), presence at st. 134), but none in June, nor in September. The very scarce occurrence at the surface in winter may perhaps indicate that the species has some difficulty in keeping alive in the Mediterranean for a longer time, and that it is maintained by a faint immigration into the Mediterranean from the west (in winter and spring?), passing over to deeper level in the inner regions.

11. UNDELLA LOHMANNI n. sp. (Fig. 54 p. 39).

U. messinensis BRANDT 1906 p. 9 p. p., pl. 64 fig. 29, 1907 p. 369 p. p. *U. lachmanni* DADAY? 1887 p. 568, based on CLAPARÈDE & LACHMANN 1858 p. 210, pl. IX fig. 5 b.

Sts. 28, 33, 68; 87, 126 (275 m. wire), 132 (600 m.—195 m.), 134 (200 m.—125 m., 350 m.—185 m.), 152 (950 m. wire), 182 (545 m. wire), 187 (945 m. wire), 189 (945 m. wire), 192 (545 m. wire, several), 194 (0 m., 1145 m. wire), 200, 204 (945 m. wire), 206 (1945 m. wire), 209 (1000 m.—200 m., 1945 m. wire), 210, 223 (1950 m. wire), 228 (1145 m. wire), 234 (200 m.—95 m.), scarce or even singly except at st. 192.

Lorica on the whole cylindrical, below the mouth somewhat dilated — the outer lamella curving outwards — then slowly narrowing by concave lateral outlines to a minimum diameter slightly above the middle of lorica proper, then again widened to a secondary maximum of diameter near the end of lorica proper, here by rounded lateral outlines passing over into a large and broad caudal prolongation, the cavity of which in the lower portion is narrowly conical, very acute, with a somewhat thickened, but single wall. The two lamellæ of wall everywhere well developed and separated, save in the pointed end, where they merge into each other. The outer lamella is particularly well developed (thickened) at the lower maximum diameter of lorica, the distance of the lamellæ greater at the widening below the mouth, as well as in the caudal prolongation, above the single-walled lower part of it. At the mouth a well-developed, rather thin-walled, but firm rim, formed by the two adjacent lamellæ; this rim is found by many species of *Undella* and allied genera. Alary plicæ rare or lacking.

Length of lorica proper 111 μ—137 μ, of caudal prolongation 45 μ—53 μ; diameter of mouth 40 μ—43 μ, at the upper maximum diameter 45 μ—47 μ, at the lower 43 μ—47 μ. The posterior, single-walled point narrow and short, 12 μ—15 μ in length × 3 μ—4$^1/_2$ μ in breadth at its base. In concentrating watery glycerine the lorica contracts easily and considerably above the middle.

Is very similar to *Undella caudata* (*U. pellucida*), but obviously specifically different from it.

In regard to the name *Undella lachmanni* I should like to point out that DADAY, when establishing this species, only knew it from the quoted figure in CLAPARÈDE et LACHMANN, giving this figure a special denomination. Later on, several similar species were found to exist; most of them were already known to BRANDT (1906). These forms he grouped under two different species, *Undella lachmanni* and *U. messinensis*. He has obviously not seen the true "main" form of the former species, but only more or less "similar" ones. A form exactly answering to the figure in Claparède et Lachmann is also as yet unknown, very probably because this, and other figures in older works were not intended to serve as a means for distinguishing a series of very similar forms, these being still unknown. These old figures should never be used for determining special forms.

In this case there are two different species or forms answering to the figure quoted, the present species and the northern *U. caudata*. The latter was, however, by BRANDT considered identical with the above described warm-water species *U. aculeata*, which in any case deserves a special name, to distinguish it from the true northern species. In my opinion, however, the present species, which BRANDT confounded with his *U. messinensis* (or referred to this species without a special denomination or mention), is more

probably that of CLAPARÈDE et LACHMANN. They agree as to shape of lorica, but the last mentioned species shows no offset caudal prolongation. They agree also as to length, this being in CLAPARÈDE's figure about 180 μ, whilst *U. caudata* in the open Atlantic is generally much shorter. Besides, CLAPARÈDE's species was taken together (?) with *U. claparèdei*, which is a warm-water species, whilst *U. caudata* is a cold-temperate one.

CLAPARÈDE's species can hardly be the same as *U. lachmanni* above, both differing considerably, in shape as well as in development of the posterior end. If this older name should be kept, it must be used instead of the well-established name, *U. caudata*, if not transferred to the present species. On account of this intricate state of things I should propose to drop the older name, considering also the improbability of any certain identification in future.

This new species proved to have a wide distribution in the Mediterranean. In winter it was only met with at two stations in the Tyrrhenian Sea in addition to one in Bay of Cadiz, in summer, however, it was present all the way from the south-western corner of Portugal as far as Euboea, but generally in deeper layers, from 100 m. to 200 m. or more. It was taken at the surface only at three stations (in summer), but in deeper layers at 14 of the 22 Mediterranean stations where deep-water samples were taken; it must therefore be frequent at deeper levels, though always very scarce.

It was first recorded for the Mediterranean by Brandt (l. c.), as taken at Messina by Lohmann.

12. UNDELLA MESSINENSIS Bdt. (Fig. 55 p. 39).

BRANDT 1906 p. 9, pl. 64 figs. 13, 30 (excl. fig. 29 and var. a).

Sts. 33, 35; 129 (600 m.—0 m., 1100 m.—0 m.), 132 (600 m.—195 m.), 134 (200 m.—125 m., 350 m. —185 m.), 170 (200 m.—85 m., here the predominant species of Tintinnidæ; 1000 m.—195 m., rather numerous), 175 (350 m. wire, predominant), 194 (1145 m. wire), 199 (945 m. wire), 204 (945 m. wire, several), 206 (1945 m. wire), 209 (1000 m.—200 m., 1945 m. wire), 234 (700 m.—200 m.). Only very scarce, if not otherwise mentioned.

Lorica of a very characteristic shape; above, at the mouth, rather thin-walled and erect, with closer set lamellae of the wall, then somewhat swollen, then again cylindrical or very slowly narrowing, by almost perfectly straight lateral outlines, to near the lower end of lorica proper, where rapidly dilated and then almost abruptly constricted, by concave lateral outlines passing rapidly over into a broad and strong caudal prolongation, similar to that of the preceding species, but with a broader and longer, single-walled point.

At the lower maximum diameter the outer lamella is still more thickened than in the preceding species, being strong enough to maintain the special shape of the lorica — at any rate in its lower part — even in concentrating glycerine-water.

Length of lorica proper 107 μ—111 μ, of caudal prolongation 38 μ—45 μ; diameter of mouth 50 μ—52 μ, upper maximum diameter 51 μ—53 μ, lower 52 μ—53 μ. The single-walled point at the posterior end rather thin-walled, 17 μ—20 μ in length by $5^1/_2$ μ—$6^1/_2$ μ broad at its base.

Several or many alary plicæ from lower end of lorica to upper of caudal prolongation, generally rather narrow.

I have reserved the specific name *messinensis* for this form, being the first figured (l. c.) under this name, in BRANDT.

This species was very rare in the winter samples, probably on account of its being rare at the surface, as is the case with many species of *Undella*. During the summer cruise it proved to be considerably rarer than the preceding species. It was not observed to occur in the Eastern Mediterranean, though recorded from deeper layers of the Sea of Marmora, at two stations, where it even proved to be the predominant species of Tintinnids.

As yet only known from the Mediterranean, first taken by LOHMANN at Messina (BRANDT l. c.).

U. messinensis "var." Brandt (l. c. p. 369, pl. 64 figs. 15, 28) is probably also a new species, different from the true *U. messinensis*, as defined above. To judge from my notes it was perhaps seen in the sample from st. 60, different from the two preceding species; I did not, however, meet with it in the summer plankton.

XYSTONELLOPSIS n. gen.

Loricæ elongated, at the mouth with a thin-walled, but firm, more or less developed, short rim, formed by the closer-set lamellæ and not offset from the rest of the lorica. A similar rim is present in many or most species of *Undella*. Wall otherwise as in the latter genus, showing two well developed and limited, and well separated lamellæ, with a more or less fine "primary" structure without greater, "secondary" meshes. Caudal prolongation provided with a similar annular or umbellate (cup-shaped) thickening as in certain species of *Xystonella*, frequently also with longitudinal plicæ and a coarse structure near this thickening, where the caudal prolongation is abruptly narrowed to a more or less subulate point.

This genus is closely allied to *Undella*, as well as to *Favella* and *Xystonella*. From the two latter genera it is easily known by the quite different mouth, with a rather thin, single rim or border, instead of a broad mouth, with an outer and inner rim (border).

1. XYSTONELLOPSIS SCYPHIUM n. sp. (Fig. 56 p. 51).

Sts. 68; 129 (1100 m.—0 m.), 132 (600 m.—195 m.), 152 (950 m. wire), 156 (950 m. wire), 184 (945 m. wire), 185, 186 (0 m., 245 m. wire, 1145 m. wire), 187 (945 m. wire), 189 (945 m. wire), 199 (945 m. wire), 204 (945 m. wire), 206 (1945 m. wire), 209 (1945 m. wire), 234 (700 m.—200 m.). Generally very scarce; at st. 186, 1145 m. wire, in somewhat greater numbers; at st. 184 (Bay of Corinth) abundant.

Lorica as in *Xystonella favata* BRANDT (1906 p. 7, pl. 44 fig. 2, pl. 47 fig. 5), but much smaller and with a shorter upper part (i. e. above the sudden narrowing) of caudal prolongation. Lorica at the very mouth slightly dilated, a little lower faintly, but distinctly, swollen, then with gradually more converging lateral outlines beautifully poculiform (see fig. 56 a), below passing over into a rather short and broad upper part of caudal prolongation, ending as usual cross-cut, but continued through a strong, but single-walled, subula, only half as broad, without visible structure.

Wall of lorica everywhere above this subulate end double, with — at any rate in the upper half — well separated outer and inner lamellæ, at the swollen portion above nearly twice as thick as in the middle, below generally less thick, but just before the upper end of subula again slightly thicker. Sometimes short and narrow plicæ are present, extending upwards from the abrupt narrowing below.

Structure exceedingly fine and inconspicuous.

The form, which was abundant at st. 184, differs slightly from the usual one in being larger and less poculiform, rather evenly and wery slowly narrowing in the upper half (in a downward direction).

Total length usually 128 μ—147 μ, rarely down to 120 μ, subula 23 μ—28 μ, diameter of mouth 45 μ—50 μ, at the swollen portion above some 6 μ greater.

Is so similar to *Xystonellopsis favata* (Brandt) that I first mistook it for this species, which, according to BRANDT, is 276 $\mu \times 87\ \mu$, i. e. about double the size. His figure seems to represent an individual, artificially compressed (squeezed) above; it differs, however, also in having a proportionately much longer upper portion of caudal prolongation, and must belong to a different species.

The present delicate species shows about the same distribution in the Mediterranean as *Xystonellopsis cymatica*; is, however, not noted for the winter cruise, and seems in summer throughout to occur at greater depths. The local abundance at Naupaktos is very remarkable.

Not yet known outside the Mediterranean, save from st. 68 in Bay of Cadiz in February. Seems to be a deep-water species of wide distribution in the Mediterranean, where recorded for 12 of the 22 stations for deep-water samples.

No indication of an immigration into the Mediterranean from outside was to be traced.

The closely allied *Xystonellopsis favata* has only been taken at one locality in the Sargasso Sea, and at one in the South Equatorial Current.

2. XYSTONELLOPSIS CYMATICA (Bdt.) (Fig. 57).

Cyttarocylis (Xystonella) cymatica Brandt 1906, p. 6, pl. 44 figs. 3, 4; 1907 p. 251, incl. var. a, pl. 44 fig. 5, pl. 45, fig. 2. Xystonella cymatica Laackmann 1911 p. 452, pl. XLIX fig. 5.

Sts. 24, 28, 68 (see var.); 86, 87, 89, 129 (600 m.—0 m., 1100 m.—0 m.), 132 (600 m.—195 m.), 134 (200 m.—125 m.), 152 (950 m. wire), 156 (950 m. wire), 160 (1000 m.—200 m.), 182 (545 m. wire), 187

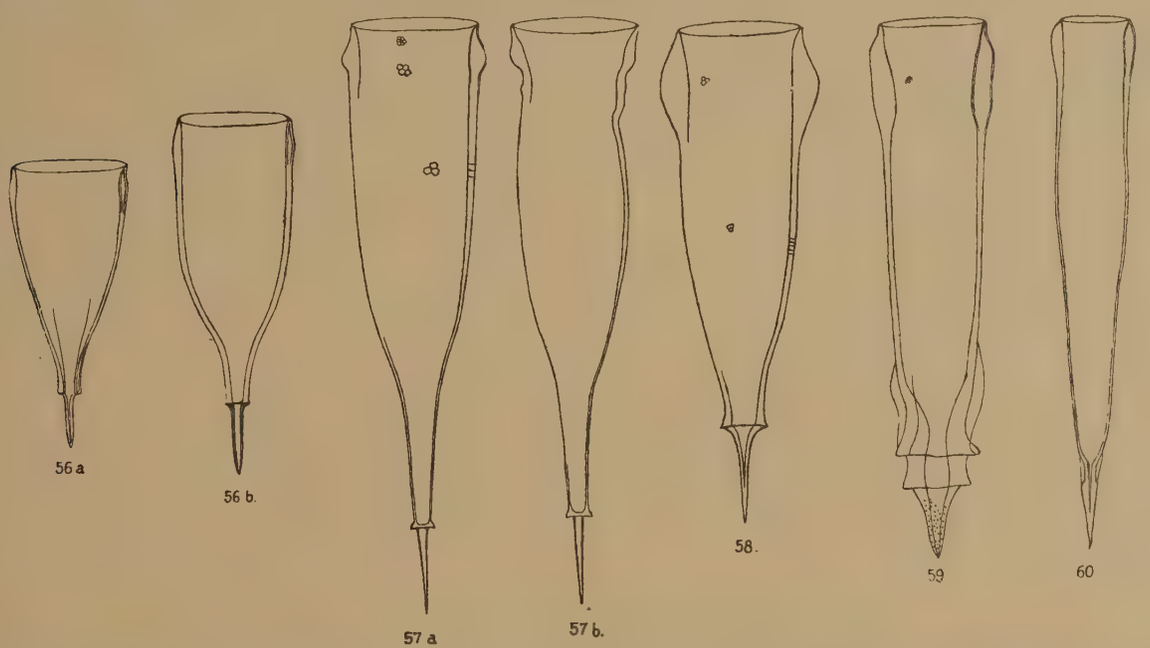


Fig. 56. *Xystonellopsis scyphium* n. sp.; $^{350}/_{1}$. a: st. 68, b: st. 184, 945 m. wire. Fig. 57. *Xystonellopsis cymatica* (Bdt.); $^{350}/_{1}$. St. 28. a: Specimen showing its natural outline. b: The same in concentrating glycerine-water. Fig. 58. *Xystonellopsis cymatica var. spicata* Bdt.; $^{350}/_{1}$. St. 68. Fig. 59. *Xystonellopsis paradoxa* (Cl.); $^{350}/_{1}$. St. 26. Fig. 60. *Xystonellopsis brandti* (Laackm.) n. sp.; $^{350}/_{1}$. St. 152, 250 m. wire.

(190 m.—100 m., 945 m. wire), 194 (0 m., 1145 m. wire), 199 (945 m. wire), 200, 206 (1945 m. wire), 209 200 m.—85 m.), 234 (200 m.—95 m., 700 m.—200 m.), but singly or (sts. 152, 187) very scarce.

Lorica swollen below the mouth, then slowly narrowing about to the middle, then again more rapidly narrowing and below passing over into a slightly offset, broad upper portion of caudal prolongation, which is slowly and evenly narrowing downwards to a slightly dilated, thickened, somewhat umbellate end. From this latter issues a much narrower, subulate, lower caudal prolongation conspicuous in water, and with hyaline, structureless, simple (single) wall. The two lamellæ of the wall otherwise everywhere separated. Thickness of wall greatest at the swollen portion above, where up to 7 μ—8 μ, at the very mouth rather small, below the swollen portion 3 μ—4 μ, towards the subula below much smaller. Meshes small on and above the swollen portion, below and towards the middle larger and more conspicuous, in the narrower portion near the subula very small.

Total length 180 μ—250 μ, length of the subulate posterior part of caudal prolongation 38 μ—40 μ, diameter of mouth 53 μ—60 μ, maximum diameter (below the mouth) 64 μ—74 μ. The different shape of BRANDT's var. a is obviously due to shrinkage (compare figs. 57 a and b).

This beautiful species was frequent in the material of the "Thor", from the Baleares as far as Euboea, as well as near the southern and south-western coast of Portugal, though everywhere very scarce. In winter it was almost absent, only noted for two stations near Naples (24, 28) and for st. 68 in Bay of Cadiz; in summer it was almost only met with in deeper layers, being only present at the surface at sts. 194, 200. It was apparently chiefly met with in layers from 100 m. to somewhat below 200 m., and was taken at 12 of the 22 stations for deep water samples (in the Mediterranean proper).

A deviating form or perhaps another species is

var. **spicata** Bdt. (Fig. 58 p. 51).

Brandt 1907 p. 252, pl. 47 fig. 4.

The swollen portion of lorica above is longer, less pronounced or localized, but very thickwalled. The upper portion of caudal prolongation — above the constriction — almost undeveloped, the lorica narrowing almost evenly to the annular thickening below where the subulate lower part takes its origin. This lower portion of caudal prolongation is also much broader at its base (in my specimen) than in the main species, and the structure in the upper part of the lorica less coarse. Is shorter than the main species, the difference answering to the difference in lengths of upper portion of caudal prolongation in both forms.

Total length 207 μ, of lower portion of caudal prolongation 42 μ; diameter of mouth 53 μ, maximum diameter 64 μ.

I saw only one specimen from st. 68 (Bay of Cadiz). BRANDT (l. c.) records it from one locality in the North Equatorial Current and from one in the South Equatorial Current, as well as from Ceylon. My specimen is slightly different from the figure in BRANDT.

Xystonellopsis cymatica was first reported from the Mediterranean by BRANDT (l. c.), as taken by LOHMANN at Messina. Otherwise it is known from the Pacific (New Pomerania, BRANDT l. c.), from the Mascarene Current in the Indian Ocean (LAACKMANN 1911), as well as from a large area in the Atlantic, from the Sargasso Sea to the South Equatorial Current, though generally everywhere rare and scarce (Brandt l. c.).

3. XYSTONELLOPSIS PARADOXA (Cl.) (Fig. 59 p. 51).

Undella paradoxa Cleve 1900 p. 974 (fig.). Cyttarocylis? (Xystonella) paradoxa Brandt 1906 p. 25. (Cyttarocylis?) Xystonella paradoxa Brandt 1907 p. 256, pl. 48 figs. 3—6.

Sts. 14, 20, 23, 25, 26, 27, 28, 31, 38, 40, 42; 126 (275 m. wire), 132 (600 m.—195 m.), 152 (250 m. wire; 950 m. wire, rather numerous), 156 (250 m. wire, 950 m. wire), 160 (200 m.—100 m., several specimens; 1000 m.—200 m.), 182 (545 m. wire), 186 (245 m. wire), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), 199 (200 m.—80 m.), singly or sparsely where not otherwise mentioned.

Lorica at the mouth slightly dilated and rather thin-walled, then swollen and very thickwalled for a considerable length, then again rather slowly narrowing in a downward direction, frequently somewhat more rapidly from the middle, to a couple of annular thickenings, one above the other, cross-cut at their lower ends and similar to the corresponding parts in the preceding species, only much larger. The lower part of lorica accordingly shows two marked annular constrictions; from the lowest of them the caudal prolongation is continued by a triangular, sharply acuminated point thick-walled at the base. The cavity of lorica stretches down to the very point, but is considerably narrowed above the upper annular thickening by a corresponding thickening of wall. From this upper annular thickening several conspicuous alary plicæ run upwards along the lower portion of lorica. Structure in the lower portion

of lorica and caudal prolongation conspicuous, consisting of rather coarse, strong-walled meshes; otherwise, it is more conspicuous and consisting of larger meshes on the swollen portion above, whilst close to the mouth the meshes are very small, and from below the swollen portion down towards the lower portion mentioned, they become very delicate or indistinct.

Total length 180 μ—230 μ, diameter of mouth 45 μ—50 μ.

The animalcule is (according to ENTZ jun. 1909) fixed at the lower point of lorica.

This very characteristic species was strikingly frequent in the material of the "Thor". In winter it apparently occurred only in the median regions of the Mediterranean, from Sardinia to the Adriatic, but was remarkably frequent in the Tyrrhenian Sea. In summer it was again only met with east of Sardinia, thence as far as the Levant and the Aegean Sea, but only in deeper layers, nowhere observed in the surface. This species also seems particularly to occur between 100 m. and 200 m. below the surface, or somewhat deeper, where it must be rather frequent, being taken at 10 of the 22 stations (for corresponding samples).

There are no direct indications of an immigration into the Mediterranean from the west; the distribution in winter would, however, apparently answer to such an immigration in late autumn (Novbr.—Decbr.(?), compare JÖRGENSEN 1920 p. 105). I have seen the species in a sample from the Straits of Gibraltar Decbr. 1908 (the Sevilla, capt. RÖD). As it is so frequent and not always scarce, it is likely to be able to keep alive all the year in deeper layers, though probably it is renewed by an occasional invasion from the Mediterranean.

It was first recorded for the Mediterranean by ENTZ 1909 (from Naples, Decbr. 1902). Otherwise it is known from the Azores (in January, CLEVE l. c.), from the South Equatorial Current frequent to the Florida Current, and from south of Madagascar (BRANDT l. c.).

4. XYSTONELLOPSIS BRANDTI (Laackm.) n. sp. (Fig. 60 p. 51).

Undella heros var. c? BRANDT 1907 p. 373. *Undella tenuirostris var. brandti* LAACKMANN 1911 p. 478, pl. L figs. 1, 2.

Sts. 14, 20, 52 (0 m., 250 m. wire, 950 m. wire), 156 (250 m. wire, 950 m. wire), 158, 161, 186 (in Salpæ), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), 194 (0 m.); everywhere but singly or very sparse.

Lorica with an erect, rather thin-walled mouth, below it swollen and thick-walled, then very gradually passing over into a cylindrical, thin-walled portion, but again from above, or at, the middle slowly tapering downwards and almost imperceptibly passing over into a broadly subulate, thick-walled point, very conspicuous in water, frequently somewhat curved or oblique towards its end. Several, more or less short plicæ are present at the upper end of the subulate point, running upwards to the lorica proper. Structure a very fine "primary" one, "prismatic elements" in several layers in the upper thicker portion of wall.

Total length 196 μ—225 μ, maximum diameter 30 μ—36 μ.

Was rare and scarce in the material of the "Thor": Eeastern Mediterranean and st. 194, north of the Straits of Messina.

Is a subtropical species, otherwise (as yet) only known from three localities: Sargasso Sea (Pl. 40, about $30^3/_4°$ N 54° W) and at the Azores (Pl. 121, BRANDT l. c.), as well as in the Mascarene Current (German South-Pole Exp. $^{15}/_5$ 1903, LAACKMANN l. c.) Such a narrow species may easily slip through the nets; it is therefore probably much more frequent, in the Mediterranean as well as outside.

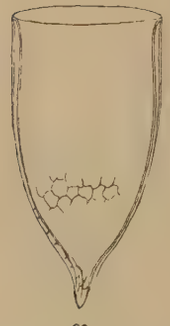
EPIPLOCYLIS n. gen.

Wall of lorica above as in *Undella*, with strongly developed and separated lamellæ. Below, the outer lamella shows a very coarse and irregular reticulation, consisting of meshes with elevated walls, but otherwise sunk, partly to contact with the inner lamella. Otherwise only a "primary" structure, frequently rather conspicuous, sometimes also a rather coarse "secondary" one, in addition to the much coarser reticulation in the lower half of lorica, just mentioned. The animalcule is as yet almost perfectly unknown. It seems to have two macronuclei.

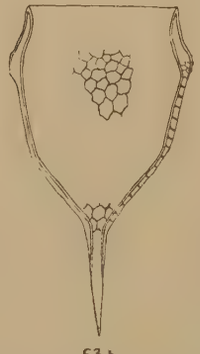
Brandt (1907) refers these species to his earlier established genus *Ptychocylis*, on account of the elevated plicæ of the outer lamella; they are, however, so different from the cold-water species which originally constituted that genus that they ought to be separated generically from them. The species of *Rhabdonella* being already removed, the rest of the genus *Ptychocylis*, answering to its original extent, make a very natural group of species. The same is the case with the present genus, comprising — in addition to the species described here below — *E. calyx* (Brandt), *E. bruhni* (Brandt), intermediate between *E. undella* and *E. acuminata*, *E. reticulata* (Ostf. et Schmidt) and the more distantly allied *E. nervosa* (Cl.).

61

63 a.



62



63 b

Fig. 61. *Epiplocylis undella* (Ostf. & Schm.); $^{350}/_{1}$. St. 152, 250 m. wire. Fig. 62. *Epiplocylis undella* (Ostf. & Schm.), *var. blanda* n. nom.; $^{350}/_{1}$. St. 152, 250 m. wire. Fig. 63. *Epiplocylis acuminata* (Dad.); $^{350}/_{1}$. a: st. 16; b: a form with a long caudal prolongation st. 23.

1. EPIPLOCYLIS UNDELLA (Ostf. & Schm.) (Fig. 61).

Cyttarocylis Undella Ostenfeld & Schmidt 1901 p. 181, fig. 30. Ptychocylis undella Brandt 1907 p. 292, incl. var. a p. 294, pl. 59 fig. 1, var. c p. 295, pl. 59 fig. 2, var. e p. 295, pl. 61 fig. 1, var. f. p. 296, pl. 61 fig. 4, var. h p. 297, pl. 61 fig. 5, var. i(?) p. 297, pl. 60 figs. 2, 4, var. k p. 297, pl. 59 fig. 4, pl. 61 fig. 6, var. l p. 298, pl. 60 fig. 1. Tintinnus mucronatus Zacharias 1906 p. 555 fig. 17.

Sts. 11, 18, 25, 68; 145 (abundant and predominating), 147, 152 (0 m., predominating; 250 m. wire, numerous; 950 m. wire, many); 154, several; 155, 156 (0 m., abundant and by far predominating; 250 m. wire, singly; 950 m. wire), 158 (many); 160 (0 m.; 30 m.—0 m., many; 1000 m.—200 m.), 161 (abundant), 162, 163 (0 m.), 165, 167, 169, 179, 180, 181, 182 (0 m., 545 m. wire), 183 (abundant), 184 (0 m., 945 m. wire), 186 (0 m.), 187 (0 m., 25 m.—0 m., 190 m.—100 m., 945 m. wire), 189 (945 m. wire), 192 (0 m., 545 m. wire), 194 (0 m.). Scarce where not otherwise noted.

Lorica campanulate, somewhat below the mouth generally slightly dilated, then narrowing slowly to about the lower $^{1}/_{3}$, where rapidly narrowed to an offset, narrowly conical caudal prolongation, very acute and with an inner channel. Wall in upper $^{1}/_{4}$ thick, with distant lamellæ; cavity of lorica slighly dilated at the very mouth, where both lamellæ unite. The wall is still rather thick in the upper part of caudal prolongation, diminishing gradually towards the lower end, which is formed by a thin- and single-walled point. The coarse reticulation in the lower portion of lorica consists of larger and smaller, roundish or polygonal meshes, extending up to lower $^{1}/_{3}$ — or somewhat more — of lorica proper, where the reticulation becomes incomplete and gradually disappears, whilst both lamellæ diverge to the normal greater distance above. Otherwise the structure consists of "primary" meshes generally easily visible.

Total length 105 μ—111 μ, length of caudal prolongation 20 μ—30 μ; diameter of mouth generally about 60 μ, (57 μ—63 μ), maximum diameter about 63 μ—65 μ (60 μ—68 μ).

Is a common and widely distributed warm-water species, considerably varying, partly as to shape, but particularly in length and diameter of caudal prolongation and in structure.

A relatively very well distinguished form, rather constant and likely to be considered a separate species is

var. **blanda** n. nom. (Fig. 62 p. 54).

Ptychocylis undella var. b Brandt 1907 p. 294, pl. 61 fig. 3, incl. var. sargassensis p. 298, pl. 60 figs. 5, 6? and var. o, pl. 60 fig. 3?

Sts. 14, 16; 152 (250 m. wire, 950 m. wire), 156 (250 m. wire, 950 m. wire), 160 (100 m.—30 m.; 200 m.—100 m., numerous; 1000 m.—200 m., several), 163 (0 m.; 80 m.—0 m., many), 164, 167, 179, 181, 182 (545 m. wire, abundant), 183, 184 (0 m.), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), 192 (545 m. wire), 194 (0 m.).

Lorica longer than that of the main species, above cylindrical, below the middle more conically and acutely narrowing into a less distinctly offset, broader and shorter caudal prolongation. Primary structure rather conspicuous and coarse.

Total length 120 μ—136 μ, length of caudal prolongation 20 μ—25 μ; diameter of mouth 60—68 μ. Wall of lorica of more even thickness than in the main species.

The Mediterranean distribution of *Epiplocylis undella* was remarkable. In winter it was only taken at three stations in the Mediterranean, one far off Naples, the two others in the Eastern Mediterranean, everywhere singly. In summer it was first met with near the south-western coast of Sicily, here, however, at once abundantly, and was afterwards very frequent throughout the Eastern Mediterranean as far as the entrance to the Dardanelles and back again to the Straits of Messina, at several stations present in greater numbers or even abundant and predominant (among the Tintinnidæ). Here, in the Eastern Mediterranean, it was present at all stations where deep water samples were taken, generally at the surface, where often in greater numbers, as well as in deeper layers. In the Western Mediterranean it was only taken in small numbers at the first station north of the Straits of Messina, st. 194.

The variety had its special distribution — which is in favour of considering it a separate species — though on the whole it was confined to the same area as the main species in summer, from st. 152 as far as the entrance to the Dardanelles and back again to the Straits of Messina and st. 194. In this area it was chiefly present only at deeper levels — in contradistinction to the main species — present at all stations for deep water samples and generally in greater numbers than the main species, though only at one station (near Euboea) common.

In the Bay of Cadiz, *Epiplocylis undella* was only taken singly at st. 68.

It is certainly an indigeneous Mediterranean species, apparently belonging to the Eastern Mediterranean, where it is strongly increasing in numbers at many places in the warmer season. An immigration into the Mediterranean from the west seems not to take place, judging from the material in question, at any rate not in summer, though there may be an occasional one in Novbr. (?) and Decbr. In this latter month the species was present in the Straits of Gibraltar (the Sevilla, Decbr. 1908, capt. Röd).

It was first recorded for the Mediterranean by Brandt (1907) from Messina, taken by Lohmann, then by Lohmann (1908) from Syracuse, by Entz 1909 from Naples and the Northern Adriatic (?, compare Laackmann 1913 p. 34). Otherwise it is widely distributed or rather common in the Atlantic, from the south point of Africa in the east, and from Rio de Janeiro in the west, as far as 38° N in the Florida Current, and north of the Azores; in the Sargasso Sea, at the Cape Verde Islands and in the South Equatorial Current also in greater numbers. Also known from many places of the Indian Ocean, where apparently frequent from 32° S in the Agulhas Current to the Red Sea, the Arabian Gulf and the Bay of Bengal. In the Pacific taken at New Zealand, together with v. *blanda*, at New Pomerania, on the west coast of South America, about 23° S (the Melderskin, Aug. 1909, capt. Jacobsen), at 4° N 94° W and at 16° N 103° W (S/S Alden, Febr. 1910, capt. Kars). According to Brandt l. c., Laackmann 1911 and my own samples).

2. EPIPLOCYLIS ACUMINATA (v. Dad.) (Fig. 63 p. 54).

Cyttarocylis acuminata v. Daday 1887 p. 578, pl. 20 fig. 33. *C. semireticulata* Biedermann 1892 p. 23, pl. I fig. 3. *Ptychocylis acuminata* Brandt 1907 p. 289, incl. *var. semireticulata* p. 290, pl. 58 fig. 9, *var.* b p. 291, pl. 58 fig. 10 and *var.* c p. 291, pl. 58 fig. 11.

Sts. 10, 14, 15, 16, 23, 24, 25, 26, 28, 29, 31, 33, 35, 36, 38, 39, 40, 42; 115, 116, 117 (common), 118, 123, 126 (0 m.; 200 m.—100 m., several; 500 m.—120 m.; 275 m. wire, common), 127, 128 (0 m.; 100 m.—0 m., common), 129 (0 m., 80 m.—0 m.; 600 m.—0 m., many; 1100 m.—0 m., abundant), 132 (600 m.—195 m., numerous; 1090 m.—57 m.), 134 (75 m.—0 m., 200 m.—125 m.), 152 (250 m. wire, 950 m. wire), 186 (245 m. wire, 1145 m. wire and in *Salpæ*), 187 (945 m. wire), 189 (945 m. wire), 192 (0 m.; 545 m. wire, several), 194 (0 m.—1145 m. wire), 199 (30 m.—0 m.; 200 m.—80 m., common; 945 m. wire), 202, 204 (1145 m. wire), 206 (1945 m. wire), 209 (80 m.—33 m.; 200 m.—85 m., several; 1000 m.—200 m., numerous; 945 m. wire, several; 1945 m. wire, many), 210, 211, 229, 237, 238. Scarce, if not otherwise mentioned.

Lorica on the whole very similar to that of the preceding species — its main form — short and widely campanulate, also varying in a corresponding manner. The main differences are that the lorica in the present species, somewhat below the mouth, is swollen and thick-walled and that the coarse reticulation extends much farther up, considerably past the middle of the lorica proper, up to or even beyond the swollen portion, where it disappears in fainter or incomplete meshes, formed by indistinct or law plicæ, not in parallel or slightly anastomosing striæ, as usual in the preceding species.

Otherwise as in that species.

Total length varying, 86 μ—140 μ, the caudal prolongation being from 17 μ to 45 μ in length. Length of lorica proper 70 μ—90 μ or somewhat more, diameter of mouth 53 μ—64 μ, maximum diameter 54 μ—77 μ.

The winter form (see fig. 63 a) answers very well to Daday's figure (total length 63 μ + 18), but has a shorter caudal prolongation; it corresponds to var. c in Brandt. Forms with a longer caudal prolongation also occur (see fig. 63 b).

In winter this species was present at all stations of the median and northern regions of the Mediterranean, but was absent everywhere in the southern Balearic and farther west. It was not taken east of Corfu. In summer it was very frequent in the same regions, in the central regions of the Tyrrhenian Sea also very frequent, often common or even abundant, but absent at the surface in the Eastern Mediterranean — only present near the Straits of Messina, sparsely — and also farther west present in much greater numbers in deeper layers, whilst frequently but singly in the surface. Now, in summer, it was also taken in the Balearic and the Catalonian Seas, but was lacking in the Atlantic Current near the north coast of Africa.

Compared to the rather nearly allied preceding species it occurs at the surface rather as a winter species and has an area, on the whole more westerly situated — though not comprising the most western regions — with an optimum over a greater area in the Tyrrhenian Sea, whereas the preceding species has its optimum east of Greece and near the eastern north-coast of Africa.

Is otherwise widely distributed in the Atlantic, from the south point of Africa in the east, and from Rio de Janeiro in the west, up to 45° N (44° W, April 1910), at any rate in the southern regions rather common (the "Fram", July—Aug. 1911). Also known from the vicinity of New Amsterdam in the Indian Ocean (German South-Pole-Exp., $^{27}/_{4}$ 1903, Laackmann 1911) and from the Agulhas Current (Brandt l. c), as well as from the west coast of South America ($45^{1}/_{2}$° S, the Alden, capt. Kars, Jan. 1910) and off Antofagasta, about $23^{1}/_{2}$° S (the Melderskin, capt. Jacobsen, Aug. 1909).

It was detected at Naples by Daday (1887) and is later reported from the Mediterranean by Lohmann (1903) from Syracuse and by Laagkmann (1913), who found it to be frequent in the northern Adriatic. As he remarks (l. c.) it is probably this species which Entz (1904 and 1909) reports as *Cyttarocylis* or *Ptychocylis reticulata* from Quarnero.

Is certainly indigeneous in the Mediterranean and — together with the preceding species — one of the more important species there, in summer chiefly occurring in deeper layers. Some invasion of this species from the Atlantic perhaps or probably takes place late autumn, though no indications of an immigration into the Mediterranean from the west are to be seen in the material in question.

PROTORHABDONELLA n. gen. ad int.

Lorica short and wide, more or less acute below; wall apparently simple (single), with few and distant, or more numerous longitudinal ribs or elevated plicæ, otherwise apparently without structure or with only the usual fine "primary" one. No caudal prolongation. Mouth simple.

Small species, intermediate between the following genus, *Rhabdonella*, and the more primitive genus *Amphorella*; they might as well be referred to this latter genus, but seem to be naturally allied to *Rhabdonella*, as representing the ancestral form of this genus.

1. PROTORHABDONELLA SIMPLEX (Cl.) (Fig. 64).

Cyttarocylis simplex Cleve 1900 d, p. 972. Rhabdonella amor var. simplex Brandt 1907 p. 331 p. p.?, Laackmann 1911 p. 463, pl. XLIX fig. 15.

Sts. 18?, 26; 156 (250 m. wire), 186 (in Salpæ).

Lorica of greatest diameter at about the upper $^1/_3$, acuminate in a downward direction, but at the very end obtuse, above slightly narrowing towards the mouth which has an abruptly, though very slightly outward curved border. Wall everywhere thin or very slightly thickened, at the mouth not thicker than below. On the outer lamella about 9 (7 to 10?) narrow longitudinal ribs, not perfectly straight, but somewhat twisted (to the left), very rarely showing up to three intermediate, fainter ribs between every two of the stronger ones. Border of mouth frequently almost erect, or indistinctly curved outwards.

Length 52 μ—58 μ, diameter of mouth 32 μ—38 μ.

In appearance similar to a species of *Rhabdonella* without caudal prolongation; wall of lorica is, however, simple (single) and there is no broader and double-rimmed mouth, as in the latter genus. I have seen no structure of the wall (save the plicæ). Laackmann (l. c.) found the animalcule to have two rounded macro- and two micro-nuclei.

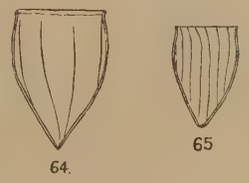


Fig. 64. *Protorhabdonella simplex* (Cl.); $^{350}/_1$. St. 26.
Fig. 65. *Protorhabdonella curta* (Cl.); $^{350}/_1$. St. 186.

This species is quite different from *Rhabdonella amor*; in the Mediterranean it was very rare and scarce. It is reported from the Adriatic by Entz jun. (1909), as *R. amor* var. *simplex*.

I have seen it from the south coast of Arabia (near Ras Ekab, Handel-Mazzetti, $^{28}/_{10}$ 1910) and from the coast of Chile (the Alden, capt. Kars, Jan. 1910). Otherwise it is known from scattered localities in the warmer regions of the Atlantic, from 20° S to the Azores and up to 56° N (Cleve l. c.), as well as from 39° S to 41° S, 13° W to 6° W (Cleve 1902 b). Also reported from the Red Sea and the Arabian Gulf (Ostenfeld and Schmidt 1901, Cleve 1903 b) and from the Gulf of Siam (Schmidt 1901).

2. PROTORHABDONELLA CURTA (Cl.) n. sp. (Fig. 65).

Cyttarocylis striata β curta Cleve 1901 a, p. 922 (fig.).

Sts. 58; 186 (in Salpæ).

Similar to the preceding species, but smaller, diameter of the mouth slightly greater, as great as the maximum diameter below, sometimes even slightly greater, with a mouth more outward curved, but

not so abruptly, as well as with more approximated striæ (plicæ), about 18 to 24, above more strongly curved on account of the mouth being curved outward for a slightly longer distance. In this species the lorica is also less acuminate in a downward direction, and the wall is less thin.

It is very similar to small species of *Rhabdonella* and is perhaps in part synonymous with *R. amor* var. *simplex* Brandt (1907 p. 331, without a figure), is, however, smaller than stated by him.

Length 38 μ—44 μ, diameter of mouth 23 μ—28 μ.

A similar, but larger form occurred (in stomachs of Salpæ) at st. 80: length 57 μ, diameter of mouth 32 μ, maximum diameter 34 μ.

I have also seen it from the Red Sea, 18° N (Handel-Mazzetti, $^{28}/_{10}$ 1910). If the form figured in Cleve (l. c.) is the same, it occurs in several places of the southern Atlantic and the southern Indian Ocean (41° S 6° W; 41° S—45° S, 29° E—76° E).

RHABDONELLA (Bdt.) Laackm.

Laackmann 1911 p. 460. Ptychocylis subgen. Rhabdonella Brandt 1906/7.

Lorica more or less elongate and narrow, with a more or less protracted caudal prolongation — seldom only rudimentary — not or but vaguely offset from lorica proper. Wall outwards with numerous and long longitudinal, raised, plicæ, simple or branched, or distantly anastomosing, almost straight or frequently somewhat twisted, always in the direction of a left-handed screw. Lamellæ distinctly developed and separated, particularly towards the mouth which is broadly dilated and double-rimmed, with an outer, more or less spreading border and an inner erect one, both very narrow and separated by a broad, but shallow groove. Denticles and collar are failing, caudal prolongation nearly always long or distinct, sometimes with a very fine opening at the end of the inner channel. Structure in part only a "primary" one, in part also a "secondary" coarser one ("*Cyttarocylis*-structure"); in addition, more scattered, greater, rounded "windows", generally in longitudinal rows alternating with the plicæ, are frequent.

The animalcule has two macronuclei (Daday 1887, Brandt 1906/7, Laackmann 1911) and presumably in a normal state two micronuclei, at any rate recorded for two species (Laackmann l. c.).

This is a very natural genus, comprising closely allied and easily known species, with a wide distribution in warmer seas.

1. RHABDONELLA AMOR (Cl.) Laackm. (Fig. 66 p. 59).

Laackmann 1911 p. 463, incl. var. indica p. 464, pl. XLIX figs. 12—14. Cyttarocylis amor Cleve 1900 d, p. 972 (fig.). Ptychocylis (Rhabdonella) amor Brandt (1906/7 p. 327, pl. 54 figs. 4, 5, 12, 13, 15 (excl. varieties).

Sts. 11, 12, 14, 18?; 80, 147, 187 (190 m.—100 m.), 189 (945 m. wire), 192 (0 m.).

Lorica in upper half almost cylindrical, only slightly dilated from the middle in an upward direction, in the lower $^1/_3$ or $^2/_5$ more rapidly narrowing towards an acute or acuminate posterior end, without a caudal prolongation. Wall with approximated, though distinctly separated lamellæ, at the mouth with a distinct annular groove and somewhat spreading outer border, though frequently not very prominent. Striæ (plicæ) numerous, about 32—36, not, or only occasionally, anastomosing.

Length 88 μ—105 μ, diameter of mouth 37 μ—51 μ.

Is a rather rare species, somewhat varying in size and shape, though on the whole easily distinguished from the allied species. In the winter material of the "Thor" I only saw it from four stations of the Eastern Mediterranean, everywhere very rare. During the summer cruise it was still rarer, being only noted for four stations, again in the Eastern Mediterranean, everywhere singly, in deeper layers save close to the Straits of Messina (st. 192).

Probably enters occasionally from the Atlantic, apparently being able to keep alive in the Eastern Mediterranean, particularly in deeper layers.

Otherwise very widely distributed in the warmer regions of the Atlantic, from 39° S (10° E) to 45° N and 50° N. Also known from many localities in the Indian Ocean. BRANDT, strange to say, records it from the Karajakfjord, which must, I think, be due to some error.

Already recorded for the Mediterranean — again the Eastern — by CLEVE (1903 b).

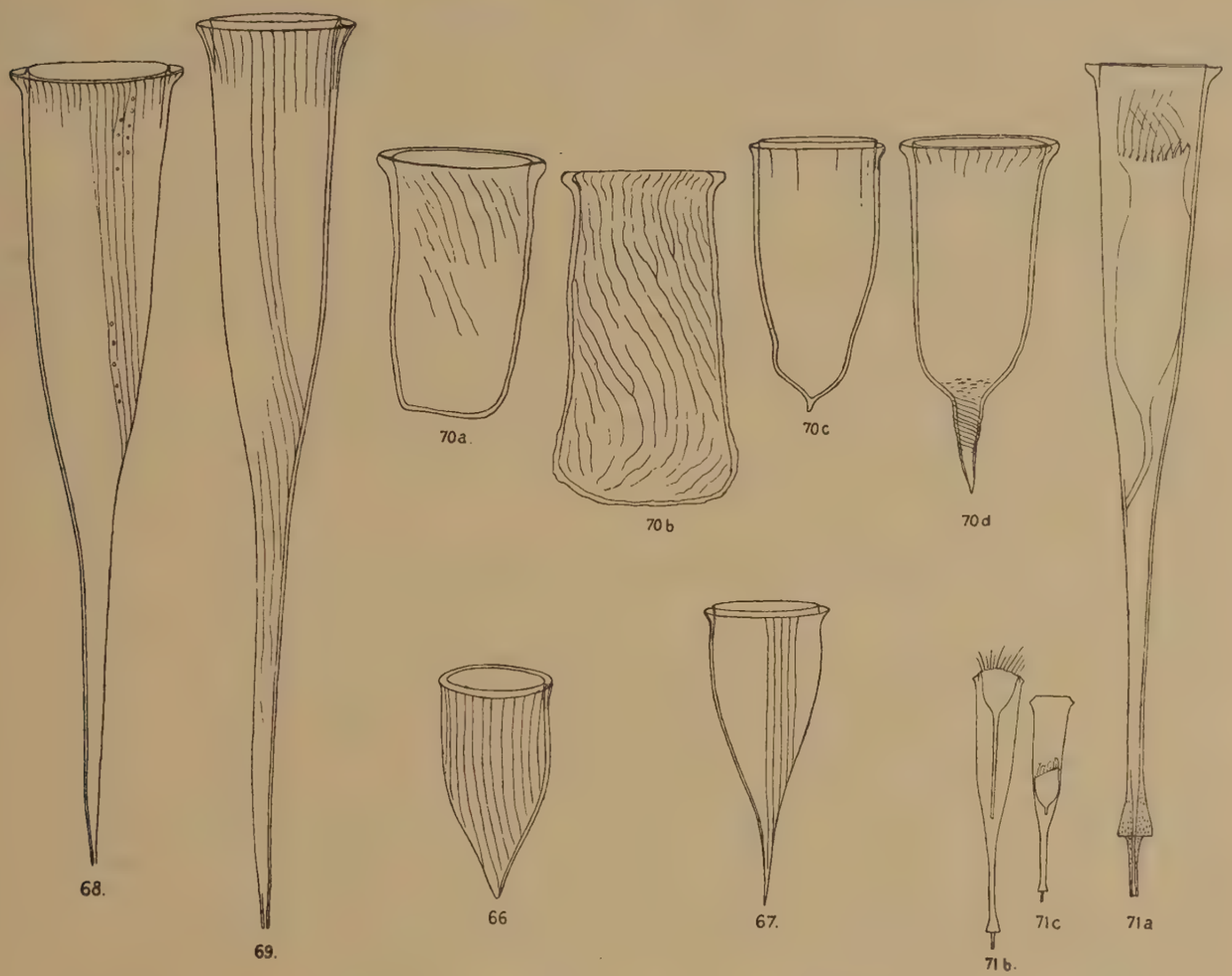


Fig. 66. *Rhabdonella amor* (Cl.) Laackm.; $^{350}/_{1}$. Tortugas $^{22}/_{5}$ 1910. Optical section of wall only shown on the right side. Fig. 67. *Rhabdonella elegans* n. sp.; $^{350}/_{1}$. St. 160. Optical section of wall shown on the left side. Striæ (plicæ) but partly shown. Fig. 68. *Rhabdonella spiralis* (Fol) Laackm.; $^{350}/_{1}$. Monaco. Fig. 69. *Rhabdonella spiralis* (Fol) Laackm., *var. elongata* n. var.; $^{350}/_{1}$. St. 158. Fig. 70. *Rhabdonella spiralis* (Fol) Laackm., *f. hydria* n. f.; $^{350}/_{1}$. a: st. 95; b: st. 152, 250 m. wire; c and d: two unfinished loricae, the latter evidently of *R. spiralis* (*var. elongata?*); c: st. 187 (0 m.), perhaps of *R. apophysata*, d: st. 156 (0 m.). Fig. 71. *Rhabdonella apophysata* (Cl.) Bdt. Tortugas, May a. June 1910. a: Sketch of a lorica containing a withdrawn animalcule, $^{350}/_{1}$. b and c: two rude and small sketches of the living animalcule in its lorica, b extended, c completely withdrawn.

2. RHABDONELLA ELEGANS n. sp. (Fig. 67).

Undella spiralis Daday 1887 p. 565 p. p. Ptychocylis (Rhabdonella) amor var. cuspidata Brandt 1906/7 p. 331, pl. 54, figs. 3, 10, 11.
Not Tintinnus cuspidatus Zacharias (1906, see the following species).

Sts. 10, 11, 14, 20, 25; 145, 147, 148, 152 (0 m., 250 m. wire, 950 m. wire), 154, 156 (0 m., 250 m. wire, 950 m. wire), 158, 160 (0 m., 1000 m.—200 m.), 161, 163 (0 m.), 165, 179, 180, 181, 182 (545 m. wire),

183, 184 (0 m.), 187 (0 m., 25 m.—0. m., 190 m.—100 m., 945 m. wire), 189 (0 m., 945 m. wire), 192 (0 m., 545 m. wire), 194 (0 m., 1145 m. wire).

Similar to a larger form of the preceding species, with an elongated caudal prolongation. It is so constant as to shape and size that — in my opinion — it should be considered a separate species. It is varying in shape, length, number of striæ and in structure, like the preceding and the following species, but is easily distinguished from them.

Length 110 μ—122 μ, diameter of mouth 50 μ—53 μ.

This species was very rare in the winter material of the "Thor", being only noted for 4 stations of the Eastern Mediterranean, and for one in the Western (off Naples), everywhere but singly. During the summer cruise it proved to be frequent, and not seldom present in greater numbers (sts. 145, 147, 152, 158, 160 (0 m.), 187 (0 m., 25 m.—0 m.), 189 (945 m. wire), 192 (0 m., 545 m. wire)) in the Eastern Mediterranean, particularly in the inner regions, yet only as far as st. 179, before the Dardanelles. In the Western Mediterranean it was only taken at st. 194, somewhat north of the Straits of Messina.

Accordingly, no indication of an immigration into the Mediterranean from the Atlantic was to be found. This species is certainly indigeneous in the Mediterranean, apparently thriving well in the Eastern Mediterranean in summer, increasing strongly in numbers, whilst in winter, apparently, it is decidedly decreasing. It was first found in the Mediterranean by DADAY, who (l. c.) referred it to the following species.

According to BRANDT (l. c.) it is known from most of the main currents in the warmer regions of the Atlantic, from 7° S (15° W) to 41° N (in the Florida Current). BRANDT also records this species from the Karajakfjord, which needs a further statement. He records it from Borneo, and I have myself seen it from the Red Sea (HANDEL-MAZZETTI, 18° 10.5′ N, October 1910).

3. RHABDONELLA SPIRALIS (Fol) Laackm. (Figs. 68, 69 p. 59).

Laackmann 1911 p. 461. Tintinnus spiralis Fol. 1881 p. 21, pl. 1 fig. 4; T. anadyomene Entz sen. 1884 p. 409, pl. 24 fig. 19. Undella spiralis Daday 1887 p. 565 (p. p.), pl. 18 fig. 8. Tintinnus striatus Biedermann 1892 p. 29, pl. 3 fig. 13. Cyttarocylis hebe Cleve 1900 d, p. 971 p. p., right fig. Tintinnus cuspidatus Zacharias 1906 p. 519 fig. 7. Ptychocylis (Rhabdonella) spiralis Brandt 1906/7, p. p., varr. a hebe, b chavesi, d striata, pp. 325, 326, pl. 52 figs. 2, 10, pl. 53 figs. 3—5.

This common warm-water species is very varying in length, numbers of striæ, structure, length of caudal prolongation and partly in shape of lorica.

The latter generally is narrowly poculiform, at the mouth frequently somewhat dilated, with a, generally somewhat spreading, outer border; below it is rather rapidly or more gradually passing over into a long and narrow caudal prolongation, frequently open at the very end. Wall of lorica distinctly double, at the mouth with very distant lamellæ, all along the outside with numerous, partly branched and anastomosing, low, longitudinal ribs or plicæ, very similar to simple striæ, usually about 30, but varying from 20 to about 40. Otherwise a more or less fine or distinct "primary" structure, sometimes accompanied by a coarser "secondary" one, showing on the optical section one to very few layers of short "prismatic elements", connecting both lamellæ. Also frequently rather larger, roundish to oval, meshes ("window"s, BRANDT) present, with or without a thickened circumference, scattered between the ribs, connecting both lamellæ. Finally, there is often also an irregular thickening of the caudal prolongation, near to its end ("Spindel" BRANDT), generally thick-walled or spongious, sometimes with very strong and close, as well as very oblique striæ.

This species was in the first instance described by FOL (1881) from Villefranche, later under a new name — on account of its peculiar and complicated structure — by BIEDERMANN (1892), and still later, for similar reasons, under a third name by CLEVE (1900), his specimens being destitute of "windows", already stated to occur in the main species by FOL. BRANDT has then tried to keep these different names by dividing the species in a corresponding series of varieties,

In the Mediterranean a very long and narrow form was found having a particularly long caudal prolongation with a more or less distinct, thickened "spindle" of varying appearance. The other forms, though varying as above mentioned, generally answer very well to the figure in FOL. They should therefore be considered typical for this species, if necessary in connection with a series of "forms", which, however, will probably be hard to distinguish one from another.

This main species was quite common and plentiful in the Mediterranean. It does not answer exactly to any of the figures in BRANDT, having more oblique plicæ and a simple caudal prolongation, without a "spindle", and, on the whole, better agreeing with the quoted figure in DADAY.

The other Mediterranean form mentioned above I have named

var. **elongata** n. var. (Fig. 69 p. 59).

Lorica much more elongated and more evenly, or almost imperceptibly, passing over into a long caudal prolongation, as long as, or frequently longer than, the lorica proper. The longitudinal plicæ but slightly oblique or almost straight, only on the lower, narrower portion of the lorica proper more distinctly oblique, on the caudal prolongation, however, again straight, parallel to the longitudinal axis. Close to the end of caudal prolongation nearly always a more or less developed thicker "spindle" is seen, mostly with a much coarser structure than usual, sometimes with coarse and close, strongly oblique plicæ (see BRANDT l. c. pl. 53 fig. 3). The posterior end of caudal prolongation very narrow, but cross-cut and apparently as a rule open. Plicæ close together, about 40—50[1].

Length 370 μ—470 μ; diameter at the mouth 66 μ—70 μ.

This form BRANDT (l. c. p. 323, pl. 52, figs. 4, 7, 8, 9) considers the main species; it is, however, so different from the figure in FOL and from the form which — according to the material of the "Thor" — is likely to be the common one at Villefranche, that, in my opinion, it should be considered a special, well distinguished variety, instead of the main form.

The distribution of this variety in the Mediterranean is very interesting. During the summer cruise it was present singly at sts. 80, 87, then in greater numbers but frequently without the spindle, at sts. 89, 91, 92, 94 (singly), 95, 96, 97 (singly), and outside the Straits; then again singly at sts. 98, 99, just inside the same. Throughout this region, from outside the Mediterranean to just inside the Straits, this variety was the only form (of *R. spiralis*) occurring. Farther on, a few individuals were taken at sts. 112, 113 on the coast of Africa, at the first station together with the main species; later, however, it does nos appear during the eastward journey until the Eastern Mediterranean, where singly and very rare in deeper layers: sts. 152 (950 m. wire), 160 (100 m.—30 m., 1000 m.—200 m.), 163 (80 m.—0 m.), 182 (545 m. wire), 184 (945 m. wire), 185. Then sporadical and rare, mostly only present in deeper layers: sts. 197, 206 (1945 m. wire), 209 (200 m.—85 m., 945 m. wire), 215, 216 (several individuals), 217, 218, 223 (1950 m. wire), 228, everywhere, save at st. 216, singly or sparsely. Farther west it becomes more frequent and plentiful: sts. 229 and 231 abundant, at the latter station also several individuals in deeper layers, st. 234 (in all catches, in greater numbers down to 100 m.), st. 235 and scarce at st. 241. Farther northwards it is gradually replaced by a shorter form without spindle, answering to forma *striata* (BIEDERMANN) BRANDT, synonymous with f. *hebe* (CL.), with "windows" and above almost straight striæ, perhaps less close together than in the common Mediterranean form: sts. 237, 238, 239, 241, 242.

Inversely, the form which I consider the main form was mostly just present, frequently also in greater numbers, where var. *elongata* was absent or very scarce. It appeared during the summer cruise

[1] The striæ being difficult to count directly, I have mostly counted on the figure — drawn by means of ABBE's drawing apparatus — the number of interstices on a median distance equal to the radius, and have multiplied this number by 6. In this way the number may be too great, owing to compression of lorica (i. e. increase of diameter).

first at st. 112, near the African coast, together with var. *elongata*, but was particularly abundant from st. 114 (in the Balearic) farther on, almost continually present and predominant (among the Tintinnids) throughout the Balearic, the Ligurian and the Tyrrhenian Seas, still predominant at the border-line of the Eastern Mediterranean, between Tunis and Sicily. In the Eastern Mediterranean it immediately became much more scarce, though present at nearly all stations and frequently the predominant species of Tintinnids, especially in the northern regions of the Aegean Sea and the Jonian Sea, in the latter partly again very numerous. On the return voyage it was still rather plentiful through the Tyrrhenian and the Balearic Seas, varying greatly in numbers, but on the whole less numerous than on the eastward journey. The same was the case in the Balearic where it was scarce at st. 217 and rather suddenly disappeared near the African Coast. Only a few individuals were seen at st. 228 in the surface, just inside the Straits of Gibraltar.

Accordingly, the main species must be supposed to be a true and indigeneous Mediterranean species, during summer increasing strongly in numbers here and there, to become abundant and predominating in the median regions of the Mediterranean, the Balearic and the Tyrrhenian Seas, but otherwise frequent and present in greater numbers all the way from about the border-line between the Alboran and the Balearic Seas as far as the entrance to the Dardanelles. An immigration from the Atlantic into the Mediterranean seems not to take place directly; it may, however, be considered probable that the main species has originally developed in the Mediterranean from forms immigrated into it from the west. From the material in question it cannot be certainly seen whether such a development from invading forms to modified, Mediterranean ones is still going on, the sudden or very uneven development of masses on the way from st. 113 to Genoa, greatest in the south (at sts. 114—118) where a branch of the Atlantic Current is protruding northwards, seems to indicate some stimulating influence of this current. Directly, it seems, however, that the var. *elongata*, numerous in Bay of Cadiz in June as well as in September, was not able to get very far inside the Straits before disappearing. The question is whether this disappearance is partly connected with a transformation into and reappearance as the other form, more adapted to the conditions of life in the Mediterranean.

We may have here a similar case to that of *Ceratium candelabrum* and *C. pulchellum* (see This Report vol. II J. 1).

Very remarkable is a presumably monstrous form of this species or of its var. *elongata*,

f. **hydria** n. f. (Fig. 70 a, b p. 59).

Lorica with a similar characteristic mouth to that of the present species, but strikingly different in shape, being short and saccate, below slightly or not narrowed or even dilated, with a cross-cut or rounded lower end. Also in structure apparently very different from the present species; at the mouth, however, the same characteristic plicæ are seen, only they are very oblique and mostly cannot be traced farther than to a small distance in a downward direction.

I have shown, for comparison, two unfinished (?) loricæ of *Rhabdonella*, fig. 70 d at any rate of *R. spiralis*, probably of var. *elongata*. On the caudal prolongation the same strong and very oblique plicæ, sometimes present on the spindle of this variety, are seen. Fig. 70 c represents perhaps an unfinished lorica of *R. apophysata*, on account of the plicæ which are distant, and above straight. Similar loricæ are here in regard to dimensions and localities counted together with f. *hydria* (proper). Sometimes the outside of the lorica in the lower portion is rugose or wrinkled, instead of plicate; sometimes the bottom of the lorica is replaced by a circular hole of great diameter, approximately as wide as the lorica itself in its lower portion.

Diameter of mouth (outside) 66 μ—70 μ; length varying, 107 μ—144 μ, number of plicæ at the mouth 36 μ—42 μ, oblique on the upper portion of lorica, or, in loricæ of greater length, almost straight.

These remarkable forms were only found singly or very sparsely, but at a remarkably great number of stations: sts. 87, 95, 98, 99, 115, 117, 129 (0 m.), 134 (125 m.—75 m., 200 m.—125 m.), 139, 140, 152 (250 m. wire), 156 (0 m.), 160 (100 m.—30 m.), 187 (0 m.), 204, 209 (0 m.), 228 (0 m.), 229.

In some of the loricæ remains of the animalcule were seen, which for some time caused me to consider these forms a separate species. This view soon, however, proved to be untenable, the variations being so extraordinarily great and pointing to an accidental development. A very important feature is the regular mouth, very exactly answering to that of *Rhabdonella spiralis*, particularly of the var. *elongata*.

It seems to me probable that we have here loricæ, developed during, or immediately after, a fission, for some or other reason not passing normally on to full development of the newly created loricæ, perhaps suddenly killed or left. One might also imagine that — by a conjugation between individuals with such very long loricæ as in *Rhabdonella spiralis* — similar short provisional loricæ were formed, later to be finished or left. In this latter case the phenomenon — these remarkable modifications as rare specimens among abundant normal ones — would be easily comprehended, though based on mere conjecture, nothing being actually known to support this supposition. There are, however, different facts at hand — particularly the large and regular aperture at the bottom in some cases, but also the incomplete, not always oblique, or, inversely, straight, striæ, as well as the early development of a caudal prolongation, seen in several cases — supporting the hypothesis that these short and apparently abnormal loricæ represent young and newly formed ones stopped in evolution. If this be correct, we should here have a proof that the loricæ are developed from the mouth backwards, and not in the shape of helicoidal bands; further, that the double wall and its different accessories — e. g. the double-rimmed mouth and the two lamellæ — are formed simultaneously, or only successively in so far as they are situated at different distances from the mouth or are undergoing a final completion. Moreover, that a later stretching of the wall, when still far from being finished, takes place to some — considerable? — extent, or a process, apparently giving the same result as if the different parts (or levels) of the young lorica continue growing (developing in size) for some time after being excreted from the animalcule.

I should like to recommend these questions for thorough examination in a place where *Rhabdonella spiralis* is present in plenty.

It seems natural to suppose a connection between these "abnormal" loricæ and the occurrence of var. *elongata*. In the Bay of Cadiz they were present together with the latter variety, not together with the main species, whilst farther into the Mediterranean they occur partly together with the same variety, partly where the latter had just disappeared.

During the winter cruise *Rhabdonella spiralis* was taken at the following stations, in small numbers if not otherwise noted: 10, 11, 12 (in greater numbers), 14 (abundant), 15 (several individuals), 16, 20, 23 (several), 24 (several), 25, 26, 28, 29, 31 (in greater numbers), 33 (several), 35, 36, 38 (rather numerous), 39, 40, 42.

As I only later arrived at the conception of the species above stated, and a later revision of the material became impossible, I dare not definitely decide whether the var. *elongata* was present in winter, or not. However, loricæ with a very long caudal prolongation, as well as others with a shorter one, answering to var. *hebe* Brandt, occurred, with, or without, a spindle. This variety in Brandt (l. c.) is founded on *Cyttarocylis hebe* Cleve (l. c.), but is different from the latter in having the greater "windows"; Cleve (l. c.) emphasizes that his species is similar to Fol's spiralis, but has not this structure. Brandt's var. b *Chavesi* (l. c. p. 326), without "windows", is therefore the true species of Cleve. I have, however, got the impression that these two forms, as well as the fourth variety in Brandt, var. *striata* (Biedermann, not. Cleve), are only unnatural varieties, without definite morphological or geographical limits, and therefore of no greater use or importance. They may, of course, very well be maintained as "forms", perhaps as geographical varieties, if later investigations should make this possible. The var. *striata* is

similar to the common Mediterranean form — the main species above — but has "straight" striæ (plicæ) in upper half of lorica.

Rhabdonella spiralis was lacking at coast stations with shallow water. It was generally also present beneath the surface where such samples were taken, but was, as a rule, scarce in deeper layers. At st. 134, however, it occurred down to 200 m. in almost as great numbers as at the surface.

This species is a true Mediterranean one, in summer — perhaps especially at an early season — present abundantly, being mostly the predominant species of Tintinnids. In summer also abundant in the Bay of Cadiz, as var. *elongata*, which, however, disappears (from the surface) just inside the Straits, thus apparently causing no direct immigration from the Atlantic into the Mediterranean, at any rate in June and September. In January and February the species, as well as the variety, were lacking in the Bay of Cadiz. The number of individuals decreases very strongly in winter, but swells strongly up again in early summer, especially in the Balearic where the Atlantic Current gives off a branch towards the Ligurian Sea.

Otherwise rather common in the Atlantic, occurring in different, more or less closely allied forms throughout the warmer and warm-temperate regions, from 26° S (in the east as well as in the west) until 51° N (22° W) and south-west of Ireland (according to Cleve 1901 d, Ostenfeld and Schmidt, Brandt l. c. and my own samples). Also widely distributed in the warmer regions of the Indian Ocean. I have seen it from the Pacific, 2° S 94° W and 15° N 102° W, at the latter locality abundant, S/S "Alden", Febr. 1910, capt. Kars).

4. RHABDONELLA APOPHYSATA (Cl.) Brandt (Fig. 71 p. 59).

(Ptychocylis) Rhabdonella apophysata Brandt 1906/7 p. 333, pl. 51, figs. 1, 2 (3—7). Cyttarocylis Hebe var. apophysata Cleve 1900 d, left fig. p. 971; C. apophysata (and C. Hebe?) Ostenfeld and Schmidt 1901 p. 179, fig. 26?

St. 89 (Bay of Cadiz).

Very closely allied to the preceding species and perhaps not certainly distinguishable from that species in all forms (of both). Is usually easily known by a strongly thickened "lance-bucket" — recalling species of the genera *Xystonella* (f. i. *X. treforti*) and *Xystonellopsis* — on the caudal prolongation, but this thickening may also be wholly or almost lacking. Otherwise similar to long and narrow forms of the preceding species, but differing from the usual, long and narrow conical appearance of these forms in having a more elegant, narrow calyciform (poculiform) shape, but slightly dilated in the lower portion of lorica proper and with a caudal prolongation of almost equal breadth, only below the thickened and usually umbellate "lance-bucket" considerably narrowing. Besides, it has much fewer plicæ, about 20—25 or up to 30.

Cleve has certainly seen the similar forms of the preceding species, f. i. var. *elongata*, with a similar, but far less regularly developed thickening of caudal prolongation, as well as forms of the present species, with badly or not developed "apophysis", and therefore described this species as a variety (of his *Cyttarocylis Hebe*, answering to the var. *elongata*). Brandt, on the contrary, makes it a special group of species ("Formenkreis"), coordinate with another, comprising the preceding three (or four) species.

I have seen living specimens at Tortugas (May 1910). The animalcule is campanulate and by a long pedicle fixed about the middle of total length — or somewhat below — to the lateral wall, about where the lorica proper narrows into caudal prolongation (figs. 71 a—c). (Compare the different statements in Laackmann 1911 p. 466, from killed specimens).

The figure given by Cleve (l. c.) answers best to Brandt's var. b, pl. 51 figs. 1, 2. This form, which also seems to be by far the most common one, should therefore be considered the main species.

I saw this species in none of the Mediterranean samples of the material of the "Thor", but only from st. 89 outside the Mediterranean (several specimens). I have, however, also seen it from Straits of Gibraltar in Decbr. 1908 (S/S "Sevilla", capt. Rõd). It was earlier observed in the Adriatic by Zacharias (1906, p. 520 fig. 8, "*Tintinnus triton* n. sp.").

Is still more frequent than the preceding species in the Atlantic, from 31° S 13° W (the "Fram", July 1911) as far as 48° N (26° W—31° W, CLEVE 1901 d). Frequent in the Florida Current; at the Azores present throughout the summer (CLEVE l. c.). Also known from the Red Sea (?, if *Cyttarocylis Hebe* OSTF. and SCHMIDT is this species without an apophysis, which seems probable, to judge from the figure quoted), the Gulf of Aden (OSTENFELD and SCHMIDT) and several places in the Indian Ocean (BRANDT l. c., and from my own samples).

TINTINNOPSIS Stein.

Lorica without caudal prolongation and without posterior aperture, or with both, the latter being a small or irregular opening at the end (or partly side) of the former, often apparently on account of rupture. Wall of lorica — where freely visible — thin and apparently homogeneous, with or without a "primary" structure, frequently in the upper portion "annulate" (helicoidal) and with agglutinated, shining or opaque, irregularly angular "foreign" bodies, scattered or close, partly or completely concealing the wall.

The animalcule has in a normal state two macro- and two micronuclei, one contractile vacuole and a number of membranelles, varying — in the different species — from 16 to 24. Peristome collar more or less distinctly lobed and in certain species provided with a single circle of stalked "tentaculoids" (see fig. I p. 4).

The numerous "foreign" bodies on wall of lorica cause this genus to be easily distinguished, though in some cases a similar incrustation, only scarcer and mostly consisting of much smaller particles, may be seen in other genera, f. i. in *Coxliella helix* — very similar to *Tintinnopsis* — in *Leprotintinnus* (Jörg., Laackm. p. p.), with a large normal, posterior aperture, and particularly in species of *Codonella* and *Codonellopsis*, as well as in *Stenosemella*, the three latter genera being — in certain species, or in all — quite similar to the present genus in regard to incrustation of "foreign" bodies.

BRANDT (1896), as well as MERKLE (1909) and others, have shown that these "foreign" bodies have a similar "primary" structure to that so generally met with in the walls of loricæ. They are therefore by BRANDT considered to be no true "foreign" bodies, but originating from the animalcule itself. ENTZ (1909) considers them to be fæcalia. This seems to me very probable, at any rate in so far as the fæcalia in certain periods of life may contain numerous similar particles, to be used for construction and stiffening of the loricæ. Their "primary" structure is in many (or most?) cases much coarser and more irregular than the corresponding, very fine, one of lamellæ.

If this hypothesis of ENTZ be correct it is easily understood that the loricæ, in rather rare cases, in addition to the usual, angular and irregular bodies may show shells of diatoms or other "true" foreign bodies (BRANDT), originating from different well-known marine organisms. It is more difficult to explain the very regularly disposed coccoliths seen in many cases by BRANDT, LOHMANN and ENTZ jun. (see also *Codonella galea*, below).

BRANDT has pointed out that the species of *Tintinnopsis*, in contradistinction to most of the other *Tintinnids*, are "hemipelagic" (neritic, in part meroplanctonic), being only met with near the coasts, not in the open sea. This has always proved to be true, and, presumably, is necessarily connected with their "foreign bodies", these probably being captured inorganic or organic particles or parts of organisms. Only in rarer cases is such building material to be had in open sea, e. g. coccoliths and particles from *Radiolaria*.

The helicoidal, "annulate", structure of the wall is seen more or less distinctly in the upper portion of lorica, in many species generally becoming very indistinct or plainly invisible farther below. This constitution of wall is probably of great advantage in connection with the incrustation, excreted bodies being easily captured and kept together by secretion of a viscous ring-shaped band (from below

the peristome collar), as SCHWEYER (1905, 1909) explains having seen the beginning of lorica-building take place. The gradual disappearing of the border-lines between the successive turns may be due to the above (p. 63) suggested growth or development of the secreted substance, in consequence of which the lines of contact (of successive turns) may be the more inconspicuous, the older they are. A further consequence of this would be that the lorica — when "annulated" above — is formed in an upward, not in a downward direction, as supposed in the case of *Rhabdonella spiralis*, which never shows an "annulated" constitution. On the other hand, there are "annulated" loricæ, where the turns (of the helicoidal spire) are undoubtedly formed in an upward direction, as for instance *Favella ehrenbergi* var. *claparèdei*; here, however, there are no obsolete border-lines, particularly not at the lower end of the helix. In this case there are two reasons for the maintenance of the lines of contact, the "annuli" are not formed in immediate connection with the building of the lorica itself, but obviously formed later, for the purpose of lengthening, and then, the double wall in *Favella* will favour the maintenance, the limiting lamellæ being of a firmer and, presumably, sooner finished consistence.

Answering to their character of neritic forms the species of *Tintinnopsis* were, on the whole, only scarce and rare in the material of the "Thor", being generally only found in harbours or at very shallow stations, sometimes in greater numbers. The distinguishing of species is difficult and requires particularly great first hand experience and plenty of material.

1. TINTINNOPSIS BEROIDEA Entz. (Fig. 72 p. 67).

Entz 1884 p. 411, pl. 24 fig. 3 (1—2, 4—9). T. beroidea var. acuminata Daday 1887 p. 547, pl. 19 fig. 4 (5). T. karajacensis var. acuta Paulsen 1904 p. 24 fig. 12. Not T. beroidea Brandt 1896 p. 56, pl. III fig. 4, nor Laackmann 1906 p. 20, pl. I figs. 6—8, nor Brandt 1906/7 p. 135, pl. 16 figs. 5, 7, 11 (incl. var. a fig. 6). T. karajacensis Merkle 1909 p. 152, pl. II fig. 14. T. acuminata Meunier 1919 p. 22, pl. XXII figs. 19, 20, not T. acuminata (Imhof) Daday 1887 p. 563.

Sts. 55, 58, 60; Falmouth (common), 79, 84, 85, 87, 89; 112, Genoa, 135, 153, 164, 170 (1000 m.—195 m.). Barcelona (in greater numbers); Lisbon, Brest (in greater numbers).

Lorica almost cylindrical, or very slightly and evenly narrowing in the upper $^1/_3$, then slightly dilated to about the same width as at the mouth; below short conically narrowing, somewhat acute or obtuse at the end, rarely with a very short and acute caudal prolongation. Very occasionally the lorica is somewhat dilated at the mouth, not infrequently very slightly conically narrowing in the upper $^2/_3$ or somewhat more. "Annuli" (always parts of a single helicoidal band) rarely distinctly visible, but seem to be generally present.

This species, having perhaps the most simply constituted loricæ of all species of *Tintinnopsis*, is remarkably difficult to limit from allied species. Is very varying in length, which is always the case with the "annulated" species of *Tintinnopsis*; statements of length should therefore always be accompanied by statements of diameter.

I have already earlier discussed the synonymy of this species (JÖRGENSEN 1912 p. 2); as it is, however, growing still more complicated, I will here briefly give the chief features. The name *beroidea* derives from STEIN; his species was taken at Wismar (Baltic), was described as having "short, wide, parabolically acuminated" loricæ, but was not figured. After STEIN the name was first used by ENTZ for a Mediterranean form; then BRANDT (1896) transferred it to another, much smaller species from the Baltic, as ENTZ's species has not been found there. Later, however, the Baltic proved to harbour more species, answering to STEIN's description, in part apparently much better than BRANDT's species; it seems therefore quite impossible to make certain which species that of STEIN really is.

On the other hand it is very probable, though not quite certain, that ENTZ's species will never be found in the Baltic, so that he was (certainly) in error, when applying STEIN's name *beroidea* to it. Nevertheless, it seems unjust to keep BRANDT's name — though it cannot be said certainly to be wrong — and to drop that of Stein, which undeniably is the more improbable one, considering that the exact

state of things properly is that no other denominations are quite safe than the following: 1. *T. beroidea* Entz 1884, the Mediterranean species, 2. *T. beroidea* Brandt 1896, the Baltic, smaller, species.

Both names may be abandoned, Brandt's to be replaced by *T. rapa* Meunier 1910, which seems to be the same species, Entz's in exchange for *T. karajacensis* Brandt (1896) var. *acuta* Pauls. Though the name *T. beroidea* in Entz is due to an error, it may, however, in my opinion be kept as *T. beroidea* Entz, without fear of any complications, unless somehow, by means of unknown figures or manuscripts,

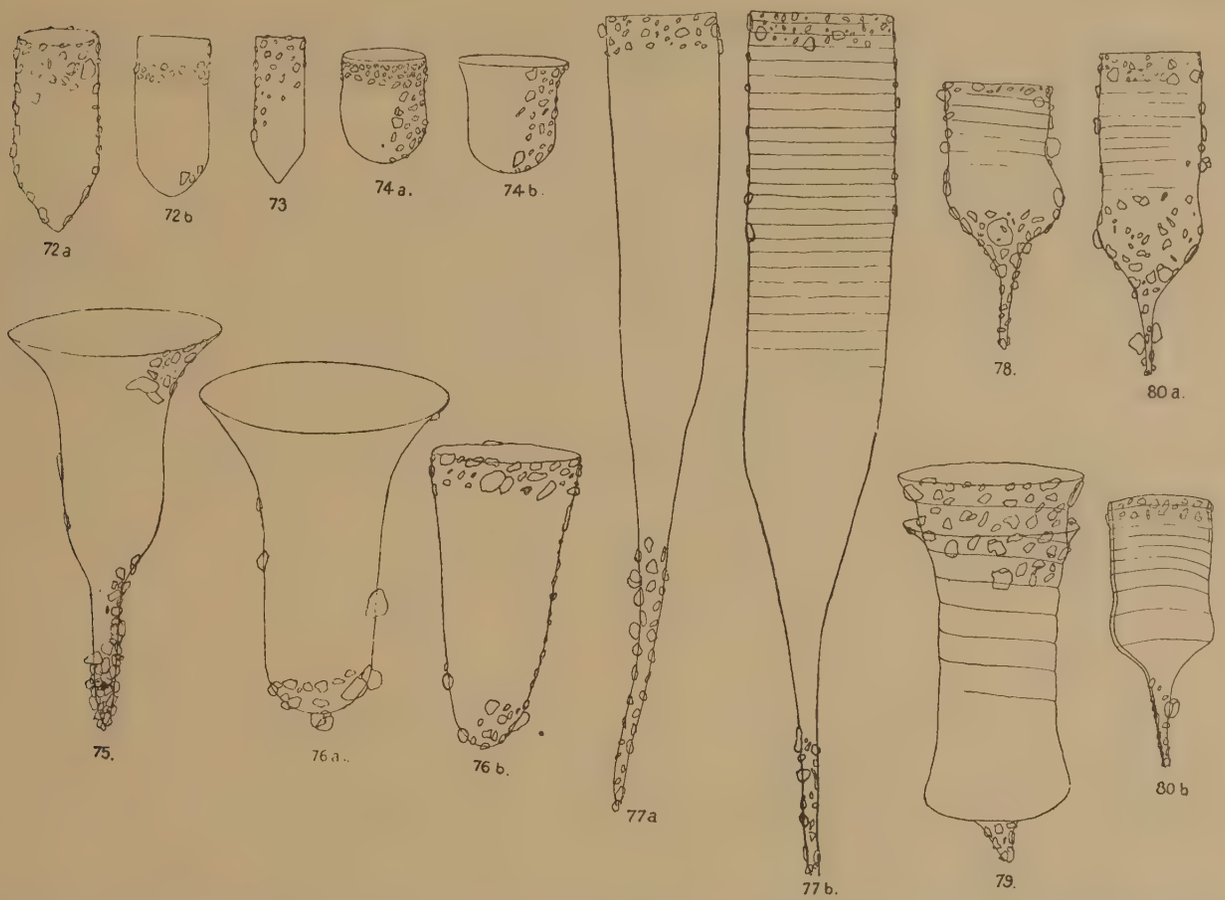


Fig. 72. *Tintinnopsis beroidea* Entz; $^{350}/_{1}$. a: St. 84; b: a more obtuse form from Barcelona. In these and the following figures the "foreign bodies" are only shown on a smaller portion of lorica. Fig. 73. *Tintinnopsis beroidea* Entz, *var. angustior* n. var.; $^{350}/_{1}$. Barcelona. Fig. 74. *Tintinnopsis compressa* (Dad.) Laackm.; $^{350}/_{1}$. a: st. 165; b: Barcelona. Fig. 75. *Tintinnopsis campanula* (Ehrb.) Dad.; $^{350}/_{1}$. Naupaktos. Fig. 76 a. *Tintinnopsis campanula* (Ehrb.) Dad., *var. bütschlii* (Dad.) Jörg.; $^{350}/_{1}$. Naupaktos. b: *Tintinnopsis campanula* (Ehrb.) Dad., *var. cyathus* (?) (Dad.); $^{350}/_{1}$. Naupaktos. Fig. 77. *Tintinnopsis radix* (Imhof) Laackm., $^{350}/_{1}$. a: st. 184, 945 m. wire. b: st. 167; a larger specimen, distinctly "annulate". Fig. 78. *Tintinnopsis angulata* Dad.; $^{350}/_{1}$. St. 184, 945 m. wire. Fig. 79. *Tintinnopsis angulata* Dad., a lorica, with another, unfinished(?) one protruding from its mouth; $^{350}/_{1}$. St. 16. Fig. 80. *Tintinnopsis lindeni*(?) Dad.; $^{350}/_{1}$. a: st. 160. b: st. 184, 945 m. wire; a shorter specimen, with distinctly double wall very similar to *T. angulata.*

the true significance of *T. beroidea* Stein might still be fixed. At any rate it seems unjust to keep *T. beroidea* Brandt and abandone *T. beroidea* Entz, which has the priority (compare Meunier l. c. p. 23).

Brandt, as well as Entz, was probably aware of the implied resemblance to Beroë; Brandt's species recalls the northern *B. forskåli* in its lower half, but wants the dilation at the mouth, the figures in Entz partly show this dilation — probably only on account of compression in slides — but are in the lower half more similar to the second Mediterranean species, *Beroë ovata*, which is nearly cylindrical

above and rounded below. Certain forms of *T. campanula*, with less developed brim and caudal prolongation, would answer still better to the diagnosis in STEIN (compare MEUNIER l. c. p. 23).

DADAY (l. c.) describes as main species a form with posteriorly evenly rounded lorica, which I myself (1899 p. 24) designated as *T. beroidea* var. *rotundata*. This form is closely allied to *T. karajacensis* BRANDT (1896 p. 57, pl. III fig. 5) and probably not distinguishable from that species. In the material of the "Thor" I only saw this form from Falmouth and have therefore not listed it here.

A form similar to *T. beroidea* Entz, but narrower and probably a separate species, is the following:

Var. **angustior** n. var. (Fig. 73 p. 67).

T. beroidea var. b Brandt 1906/7 p. 138, pl. 16 fig. 15, pl. 19 fig. 22. T. beroidea var. compressa Fauré-Fremiet 1908 p. 234 fig. 20, not Daday 1887.

Lorica as in the main species, but proportionately and absolutely narrower.

Length 54 μ, diameter of mouth 22 μ.

Barcelona, in greater numbers than the main species; st. 226.

It should be remembered that such a narrow form will easily slip through the net.

This variety is very similar to *Tintinnopsis fistularis* MEUNIER 1919 p. 23, pl. XXII, fig. 21 — not *T. fistularis* CLEVE 1900 a p. 17 —, but this species (of MEUNIER's) is smaller, according to the figure quoted 45 μ in length, 15 μ in diameter. This latter species seems very closely allied to *T. minima* (ENTZ 1909 p. 133, pl. IX fig. 4, as *Tintinnus minimus*), which, however, is stated to be considerably narrower, 8 μ—10 μ in diameter. I did not see it in the material of the "Thor".

Otherwise, *Tintinnopsis beroidea* Entz is common on the European temperate coasts, from the coasts of Portugal and Bay of Biscay to the North Sea, Skagerrack and the west coast of Norway.

2. TINTINNOPSIS COMPRESSA (Dad.) Laackm. (Fig. 74 p. 67).

Laackmann 1913 p. 14, pl. I figs. 10—15. T. beroidea var. compressa Daday 1887 p. 548, pl. 19 figs. 7, 8.

Sts. 165, 170 (1000 m.—195 m.), 172 (200 m.—51 m.), 175 (1150 m. wire), 184 (945 m. wire), 190, Barcelona; everywhere but singly.

This seems to be a well-established species. Lorica almost as wide as long, towards the mouth often considerably and more or less rapidly dilated, frequently with a strongly spreading border; diameter less great in the middle or somewhat above, then again greater. Below the lorica is rounded. Not infrequently the lorica is evenly dilated upwards, towards an obliquely erect or spreading border, and not narrowed in the middle. "Foreign" bodies numerous, particularly towards the mouth; "annuli" very indistinct to invisible, a few near the mouth are sometimes more distinctly visible on less incrusted loricæ.

Exceptionally, elongated loricæ, distinctly "annulated" above, occur, in shape above like a short, cylindrical "collar", at its base distinctly surrounded by the earlier border of mouth.

Length (normally) 45 μ—54 μ, diameter of mouth 34 μ—48 μ, minimum diameter (near the middle) 31 μ— 38 μ.

DADAY caught it frequently at Naples in April; according to LAACKMANN also frequent in the Adriatic.

I have seen it from the Red Sea (Dshedda $^1/_{11}$ 1910, HANDEL-MAZZETTI). It is recorded by CALKINS from Woods Hole (Massachusetts), but seems to belong to warmer coasts.

3. TINTINNOPSIS CAMPANULA (Ehrb.) Dad. (Fig. 75 p. 67).

Daday 1887 p. 558, pl. 20 figs. 9, 11, 13, 15. Tintinnus campanula Ehrenberg 1840.

Sts. 12, 16, Naupaktos (in greater numbers), 23, 27 (in greater numbers), 28, 31, 53, 55, 58, 59, 60, 62, 64 (many individuals), 66, 68; 84, Cadiz, 101, 109 (in greater numbers), Genoa, 164, 170 (80 m.—20 m., 200 m.—85 m., 1000 m.—195 m.), 184 (945 m. wire), Naples, Barcelona, 213, 226, 228 (0 m., 1145 m. wire), Gibraltar, Lisbon, 237, 238, Brest, 249. Singly or sparsely, if not otherwise noted.

Lorica generally of elegant shape, above more or less broadly widened to an obliquely erect or strongly spreading and very broad border or brim. Below, the lorica usually narrows into a shorter or longer, very often oblique, caudal prolongation. "Annuli" not very distinct, but generally visible above, sometimes as far as below the middle.

In a swimming state the animalcule extends considerably beyond the mouth of the lorica, supporting unilaterally on the broad brim of mouth (see fig. I p. 4). It has two macro- and two micronuclei; on the inward border of peristome collar are found the peculiar "tentaculoids", already detected by HAECKEL and later seen by SCHWEYER, ENTZ jun. and FAURÉ-FREMIET.

This species, common also on northern temperate coasts, is very varying (compare JÖRGENSEN 1899 p. 22). The brim of mouth is frequently less developed; an extreme form in this respect is

var. **cincta** (Dad.) Jörgensen (l. c.).

T. cincta Daday 1887 p. 557, pl. 20 figs. 6—8, not Tintinnus cinctus Claparède et Lachmann. Codonella campanella Haeckel 1873 p. 567, pl. 28 figs. 11—14; C. urniger Entz 1884 p. 412, pl. 24 fig. 23. Tintinnopsis annulata Daday?, 1887 p. 550, pl. 19 fig. 17.

This variety is frequent, also in the Mediterranean, often together with the main species and intermediate forms.

Much more rarely the caudal prolongation — which is very varying as to development — is lacking. Such a form is

var. **bütschlii** (Dad.) Jörg. (l. c. p. 23) (Fig. 76 a p. 67).

T. bütschlii Daday 1887 p. 556, pl. 20 figs. 4, 5.

Sts. Naupaktos, 64; Cadiz.

Closely allied to this latter variety is (apparently) *T. cyathus* Dad., incl. var. *annulata* Dad., l. c., pl. 20 figs. 2, 3, a form with a less developed brim of mouth (see fig. 76 b). *T. infundibulum* Dad. (l. c. p. 559, pl. 20 figs. 17, 18) may, however, be another species. I only saw a single individual of a similar species, below, however, more narrow and rounded, without a caudal prolongation: length 132 μ, diameter of mouth 54 μ, in the middle 30 μ; indistinct "annuli" (st. Naupaktos).

Tintinnopsis campanula was already recorded for the Mediterranean by FOL 1881 (from Villefranche).

4. TINTINNOPSIS RADIX (Imhof) Laackm. (Fig. 77 p. 67).

Laackmann 1913 p. 17, pl. II figs. 17—31. Codonella radix Imhof 1886 p. 103, 1891 p. 4. Tintinnopsis davidoffi Dad. 1887 p. 552, pl. 19 figs. 23, 25, 26 (var. longicauda); T. curvicauda Daday l. c. p. 554, pl. 19 fig. 33. T. fracta Brandt 1906/7 p. p., pl. 23 fig. 4.

Sts. 109, 110, Genova, 156 (950 m. wire), 165, 167, 168, 170 (0 m., 200 m.—85 m., 1000 m.—195 m.), Constantinople, 172 (17 m.—0 m.), 174, 175 (0 m.), 185, 186 (0 m., 245 m. wire, 1145 m. wire).

Lorica long and narrow, almost cylindrical in the upper half, then narrowing — or shorter and narrowing from the very mouth — and usually passing over without any limit into a more or less elongated, frequently oblique or flexuose caudal prolongation. "Annuli" usually visible in upper half, or not rarely as far as to the caudal prolongation, on strongly incrusted loricæ often apparently lacking (obliterated?).

Total length up to 220 μ, according to LAACKMANN up to 500 μ, diameter of mouth 43 μ—53 μ.

Seems to be common on the Mediterranean coasts, particularly in the innermost regions, as far as into the Black Sea. In the material of the "Thor" it was generally scarce — like species of *Tintinnopsis* on the whole — at sts. 110, 174 and 175, it was present in much greater numbers and the predominant species of *Tintinnidæ*.

Otherwise it seems to have a wide distribution along the coasts of warmer regions.

In regard to BRANDT's species, *T. fracta* and *T. aperta*, with irregular apertures at the end and partly at the sides of caudal prolongation, it seems to me by far the most probable explanation that these openings are due to fractures in preserved material, perhaps particularly in alcoholic samples. I

saw several similar cases in the material here dealt with; sometimes nearly the whole caudal prolongation was broken off. The two species mentioned also otherwise seem to me to be more artificial than natural species, the difference between them in part being ruled by a more or less inconsiderable or even indistinct dilation in the lower portion of lorica, whilst the more important width or diameter varies too much in one and the same "species", at any rate in *T. aperta.*

5. TINTINNOPSIS ANGULATA Dad. (Figs. 78, 79 p. 67).

Daday 1887 p. 561, pl. 20 fig. 22; Laackmann 1913 p. 26, pl. IV figs. 48—53.

Sts. 135, 160 (0 m.), 162, 163 (0 m., 80 m.—0 m.), 164, 165, 167, 181, 182 (0 m., 545 m. wire), 183, 184 (0 m., 945 m. wire), 185, 186 (0 m., 245 m. wire, 1145 m. wire, in Salpæ), 187 (190 m.—100 m.), 189 (0 m., 945 m. wire), 190, 192 (0 m., 545 m. wire), 194 (0 m., 1145 m. wire), Naples, 218, 220, 221, 223 (1950 m. wire), 226, 228 (0 m.), Gibraltar.

Lorica almost cylindrical, slightly and as a rule evenly dilated towards the mouth, more rapidly towards the lower end and frequently to a greater width than above, then rapidly or almost abruptly constricted to a rather short, straight or frequently oblique or curved, very acute, caudal prolongation. Somewhat broad (high) "annuli" nearly always distinctly visible from the mouth to below the middle. Foreign bodies mostly rather scattered.

Length 68 μ—96 μ, diameter of mouth 40 μ—57 μ, caudal prolongation 25 μ—37 μ in length, at the base rather broad, but very narrow towards the end.

Very varying. Daday's species is a form with a conspicuous and abrupt dilation towards the lower end of lorica proper, and then an abrupt constriction to the caudal prolongation. Sometimes the lorica is widest at the mouth, with or without a second widening below.

Is very similar to *Coxliella helix* which, however, is larger, has a thicker wall with distinctly developed and seperated outer an inner lamellæ, much more strongly marked border lines between the "annuli", and usually few and scattered foreign bodies, as well as a coarser "secondary" reticulation.

At st. 16 a considerably deviating form was taken, apparently a form of the present species. I have figured it here as an instance of the peculiar looking loricæ, having the upper portion of another lorica protruding from the mouth. The older lorica was apparently elongated after being finished, the new portion being surrounded at its base by the spreading border of the older lorica. (Perhaps the new lorica may have been built by a daughter animalcule not getting loose after fission).

Laackmann (1906) figures the same case in *T. campanula* and *T. karajacensis.* Also in loricæ having an erect mouth a superposed, new portion may be seen, in rare cases, though not so distinctly offset.

In the material of the "Thor" this species was relatively frequent and sometimes rather plentiful: sts. 183 (many specimens), 190 (the predominant species of Tintinnids), Naples (several individuals). In the list above forms intermediate to the following, closely allied, species are included.

Was first recorded for the Mediterranean by Daday (1887) and afterwards by Laackmann (1913); it is, however, probably the same species which Entz jun. mentions and figures (1904) as *Codonella orthoceras* and (1909) as *Cyttarocylis helix* (see Laackmann l. c. and the following species).

Otherwise, it seems only observed (as yet) in Gulf of Siam (?) (Schmidt 1901 p. 186, as *T. lindeni* Dad.).

6. TINTINNOPSIS LINDENI Dad. (Fig. 80 p. 67).

Daday 1887 p. 560, pl. 20 fig. 23. Codonella orthoceras Entz 1904 p. 127 fig. 10 (figs. 12—23?); Cyttarocylis helix Entz 1909 pl. 11 figs. 6—8, pl. 12, figs. 10. 11. Tintinnopsis helix Laackmann 1913 p. 24, pl. III figs. 37—42? (43—47?).

Sts. 106, 114, 160, 174, 185, 206 (1945 m. wire), 210.

Lorica generally more elongated than in the preceding species, almost cylindrical, but mostly somewhat narrower below the middle and again slightly dilated towards the lower end, which is rapidly

rounded or short conical, with a generally distinctly offset, rather short and frequently oblique caudal prolongation. Wall rather thick, without very distinctly developed or separated outer and inner lamellæ, but with a rather conspicuous "primary" reticulation. Foreign bodies rather scattered. "Annuli" mostly distinct as far as below the middle or towards the end of lorica proper.

Length of lorica proper 132 μ—170 μ, of caudal prolongation 28 μ—55 μ; diameter of mouth 43 μ—49 μ, below somewhat less or somewhat more.

Is very similar to *Coxliella helix* (see below), but has not the thicker wall of the latter species, nor the distinctly developed outer and inner lamellæ and their relatively coarse "secondary" (double) structure. *Coxliella helix* is also mostly a larger species.

The figure of *T. lindeni* in DADAY (l. c.) does not answer very well to the diagnosis, but rather — or as well — to forms of the smaller, preceding species. He states, however, rather different lengths, of *T. lindeni* 180 μ, of *T. angulata* 144 μ (caudal prolongation included). In the "annulated" species the length is, however, an unstable character; also forms are frequent, apparently belonging to the preceding species, but differing in the same way as shown in DADAY'S figures of both species (chiefly in the more abrupt bulging out below of *T. angulata*). I was only lately aware of the possibility that *T. lindeni* might be another species than *T. angulata*, first on account of the difficulties which LAACKMANN (l. c.) found in distinguishing between his *T. helix* and the latter species, then on account of the plentiful occurrence of both forms together at st. 185, without any disturbing intermediate forms.

BRANDT has also referred species, apparently belonging to *Tintinnopsis*, to his *Coxliella helix*; see f. i. BRANDT 1906—7 pl. 29 figs. 4—12 and pl. 30 fig. 2, from Naples, this latter being apparently the present species.

At present, I find a difficulty in believing that there really exist intermediate forms passing imperceptibly over into species of *Tintinnopsis* on the one hand, and into *Coxliella helix* on the other.

In LAACKMANN'S figures the optical section of wall is generally not to be seen, but will in this case be decisive; the chief question is whether in fully developed — not in young — loricæ of the above "*T. lindeni*" the outer and inner lamellæ are developed in a way or to a degree, not too inferior to that in *Coxliella helix*. That the typical *T. angulata* does not possess this character, having only the usual simple wall of *Tintinnopsis*, seems to be certain. I should wish to recommend this rather important question for special investigation, having never seen any doubtful forms of *Coxliella helix* in our northern waters, where this species, however, is scarce. The material of the "Thor" was, as mentioned above, only poor in corresponding material.

It is very probable that the present species also comprises forms of lesser length, and that these above have been listed together with the preceding species. An essential difference between both seems to be the ordinary thin wall in *T. angulata*, as against the thicker, indistinctly double one in the present species, which in any case seems to be a noteworthy connecting link between the genera *Tintinnopsis* and *Coxliella*.

COXLIELLA (Bdt.) Laackm.

Laackmann 1911 p. 454. Cyttarocylis subg. Coxliella Brandt 1906 p. 7.

Wall of lorica always nearly double and with well developed and separated lamellæ, rarely — in the first species below — apparently single or with two, imperfectly separated, lamellæ. Structure very fine and indistinct or mostly a coarse, double ("secondary") one, similar to that of *Favella* ("*Cyttarocylis*-structure"). Wall throughout the lorica formed by a single, helicoidal band, with superposed turns of varying height. No regular denticles at the mouth.

Animalcule possessing two macro- and two micronuclei.

Loricæ generally very similar to those in *Favella*, but easily distinguished through "the annuli", the dividing lines being usually conspicuous in the optical section of wall. Only a couple of species are in some way intermediate between the present genus and the others, *Favella azorica* and particularly *F. ehrenbergi* var. *claparèdei*, with an "annulated" upper portion, distincly limited from a lower, non-annulated one.

One species, *Coxliella helix*, seems to have a close connection with *Tintinnopsis*, just discussed in the preceding species.

I. Subgenus PROTOCOCHLIELLA n. subg.

Wall of lorica (in fully developed specimens) apparently simple (singly) or with two imperfectly separated or developed lamellæ. Structure very fine or indistinct, apparently consisting of a very fine and pallid "primary" reticulation, or corresponding "prismatic elements" (or perhaps fine elevated plicæ, the 'annuli" apparently having uneven borders).

1. COXLIELLA AMPLA (Jörg.) Laackm. (Fig. 81 p. 73).

Laackmann 1911 p. 456. Amphorella ampla Jörgensen 1899 p. 17, pl. I figs. 4 a, b. Cyttarocylis? (Coxliella) ampla Brandt 1907 p. 272. Cyttarocylis spiralis Meunier 1910 p. 119 p. p., pl. IX fig. 18, not C. spiralis Ostf. & Schm. 1901 (p. 188).

This northern species was not present in the material of the "Thor", but is mentioned here, as it may easily be confounded with the following species. Lorica of similar shape and appearance as in that species, but generally short and wide, and rounded below, without a caudal prolongation. It is also much more thin-walled and pellucid, with a very indistinct or invisible structure.

Length 85 μ—107 μ, diameter of mouth 70 μ—85 μ.

A closely allied species, *Coxliella frigida* Laackmann p. p. (1911 p. 392, pl. XLIV fig. 4, pl. XLV fig. 2) is present in the Antarctis.

II. Subgenus COCHLIELLA n. subg.

Wall of lorica with well developed and separated lamellæ and a more or les distinct or coarse "primary" structure, mostly also with a coarser "secondary" one.

2. COXLIELLA LACINIOSA (Bdt.) Laackm. (Fig. 82 p. 73).

Laackmann 1910 p. 450. Cyttarocylis (Coxliella) ampla var. laciniosa Brandt 1906 p. 20, pl. 28 figs. 1, 2, 4, 5 (var. lata Brandt), pl. 29 figs. 2 (var. lata), 3; Cyttarocylis? (Coxliella) laciniosa Brandt 1907 p. 270.

Sts. 16, 31, 60; 116, 128 (100 m.—0 m.), 145, 147, 152 (0 m., 250 m. wire, 950 m. wire), 156 (0 m., 250 m. wire, 950 m. wire), 158, 160 (0 m., 30 m.—0 m., 200 m.—100 m., 1000 m.—200 m.), 161, 163 (0 m., 80 m.—0 m.), 165, 182 (545 m. wire), 183, 187 (0 m., 190 m.—100 m., 945 m. wire), 189 (945 m. wire), 209 (80 m.—0 m., 1000 m.—200 m.). Everywhere very scarce or only found singly.

Lorica campanulate, below rapidly narrowing to a short and mostly acute caudal prolongation, the latter occasionally lacking. Thickness of wall greater in the upper half (of length); "annuli" narrower towards the mouth, generally seven or more.

Length of lorica proper 90 μ—105 μ, of caudal prolongation 5 μ—15 μ; diameter of mouth 55 μ—64 μ, consequently proportionately narrower than the preceding species.

No "secondary" structure, only a "primary" one.

Is a rather common warm-water species, also rather frequent in the Mediterranean, particularly in summer and in deeper layers of the inner regions. In winter it is apparently very rare at the surface.

Otherwise the species is widely distributed in the warmer regions of the Atlantic, at any rate from 30° S 9° W (the Fram, July 1911) to 42° N (16° W) (according to Brandt 1907, Laackmann 1911

and my own collections). Also known from the Indian Ocean and the Pacific (New Amsterdam, LAACKMANN l. c., New Pomerania, BRANDT l. c.; south-east coast of Arabia, at about 51° E., Handel-Mazzetti, Octob. 1910). First recorded from the Mediterranean by BRANDT 1907 (from Messina, taken by LOHMANN).

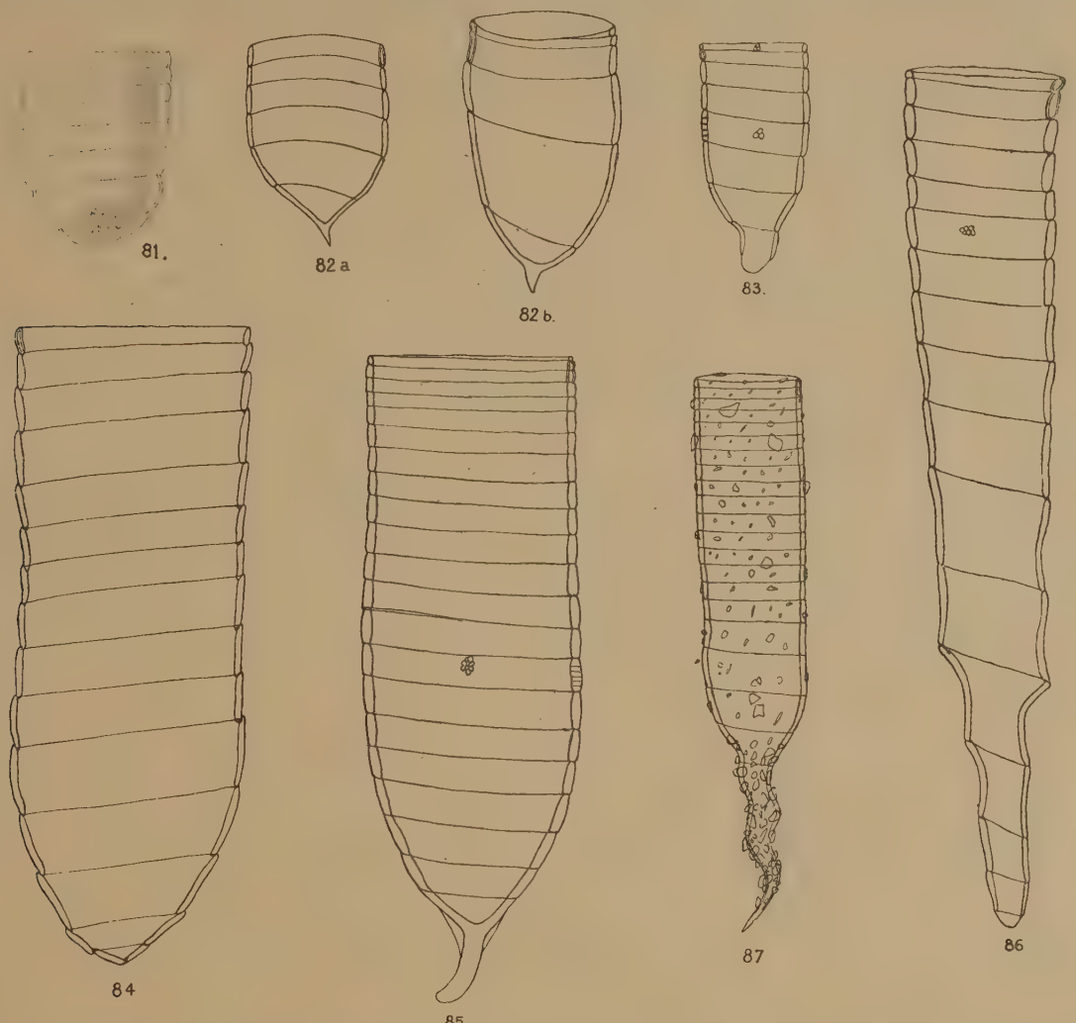


Fig. 81. *Coxliella ampla* (Jörg.) Laackm; $^{300}/_{1}$. Puddefjord, Bergen, $^{29}/_{11}$ 1898. Fig. 82. *Coxliella laciniosa* (Bdt.) Laackm.; $^{350}/_{1}$. a: st. 152, 950 m. wire; b: st 16. Lamellæ only shown at one side of the upper portion. Fig. 83. *Coxliella pseudannulata* (Jörg.); $^{350}/_{1}$. S/S "Dronning Olga", $^{25}/_{4}$ 1910, far southeast of Nova Scotia. Fig. 84. *Coxliella annulata* (Dad.) Entz. jun. $^{350}/_{1}$. Naples. Fig. 85. *Coxliella decipiens* n. sp.; $^{350}/_{1}$. Naples. Fig. 86. *Coxliella fasciata* (Kof.) Laackm.; $^{350}/_{1}$. St. 182, 545 m. wire. Fig. 87. *Coxliella helix* (Clap. et Lachm.); $^{350}/_{1}$. St. 174.

Beside the above species, *Coxliella ampla*, there is another northern one, likely to be confounded with the preceding, namely

3. COXLIELLA PSEUDANNULATA (Jörg.) (Fig. 83).

Cyttarocylis pseudannulata Jörgensen 1901 p. 15, pl. II fig. 28. Tintinnus(?) calyptra Cleve? 1899 a, p. 24 pl. I fig. 2. Cyttarocylis(?) calyptra Cleve? 1901 d, p. 108. Cyttarocylis pseudannulata Brandt 1906/7 p. 269, pl. 28 fig. 8, pl. 29 fig. 1, incl. var. calyptra p. 270; C. spiralis Meunier 1910 (p. p.), pl. IX fig. 19 (20?); C. sp. Meunier l. c. pl. XXIII fig. 12.

Is usually smaller and particularly narrower than the preceding species (diameter 40 μ—60 μ), with a more or less distinct "secondary" structure, showing a single layer of "prismatic elements" bet-

ween both lamellæ (in the optical section appearing as unbroken short lines, "*Cyttarocylis*-structure"). Mouth of lorica usually irregularly denticulate.

Subarctic species, extending from the west coast of Norway to Spitzbergen and Novaya Zemlya. I have also taken it at the border region between the Florida and Labrador Currents far south-east of Nova Scotia (41° N 59° W, Apri 1910). Not present in the Mediterranean.

The quoted figure in CLEVE strongly recalls certain species of Radiolaria (Polycyrtids), particularly on account of the structure. If this figure really represents a Tintinnid, the specific name of the present species ought to be *calyptra* (Cl.).

This species also has a representative in the Antarctis, the allied species *Coxliella intermedia* Laackm. (p. p.) 1911, pl. XLV fig 6.

4. COXLIELLA ANNULATA (Dad.) Entz jun. (Fig. 84 p. 73).

Entz jun. 1909, pl. 10 fig. 1 (6?). Cyttarocylis annulata Daday 1887 p. 582, pl. 21 fig. 6. Tintinnus zonatus Zacharias 1906 p. 525 fig. 11. Cyttarocylis (Coxliella) annulata Brandt 1907 p. 267.

Sts. 85 (singly), Naples (in August, several specimens).

A large species, with a lorica of not very firm consistence, similar to that of *Favella ehrenbergi*, to which it may be somehow allied.

Lorica almost cylindrical, towards the mouth frequently slightly dilated, more distinctly — though very slowly and evenly — widened towards the lower $^1/_3$, then rapidly and conically narrowed to the end, without a caudal prolongation (and without alary plicæ). "Annuli" very conspicuous to the very end, towards the mouth frequently narrower (lower), also narrower at the lower end, broadest at about lower $^1/_3$. Thickness of wall rather great; "annuli" (turns of the helix) very conspicuous on the optical section of wall, their upper border overlapping the lower one of the superposed "annulus".

Length 272 μ—315 μ or somewhat more, diameter of mouth 85 μ—90 μ, maximum diameter (below) up to about 95 μ. Thickness of wall about 4 μ—5 μ.

It was of great interest to find DADAY's beautiful species, the name of which was earlier repeatedly misapplied, also by myself (1899). It proved to answer very accurately to his figure and the dimensions stated. It is a very well defined species, easily distinguished from allied forms, particularly by the very characteristic lower end. It was detected at Naples by DADAY (1887) and afterwards figured by ZACHARIAS 1906 as a new species from the northern Adriatic. Perhaps it is the same species which LOHMANN mentions as *Codonella annulata* Clap. et Lachm. 1903 from Syracuse, having changed the name in 1908 to *Cyttarocylis annulata* Dad. ENTZ jun. reports it 1909 from the northern Adriatic and Naples, THEODORO 1922 from Venice.

Most probably a neritic species, being very rare in the material of the "Thor" and not mentioned in CLEVE (1901 d) from the open Atlantic; may be present near the coasts in many places; as yet, however, only observed in the Mediterranean and near Lisbon.

5. COXLIELLA DECIPIENS n. sp. (Fig. 85 p. 73).

Coxliella annulata Entz jun. 1909 (p. p.), pl. 10 fig. 4 (?, 5?).

Naples, in August.

Lorica very similar in shape to that of the preceding species, differs, however, in being elongated below into a short, but generally not very thick, caudal prolongation, straight, or frequently curved, as a rule apparently conically widening above on account of three alary plicæ, extending up to lower portion of lorica proper, as in *Favella ehrenbergi* var. *helgolandica*.

The helicoidal line separating the "annuli" is less distinct than in the preceding species, being rather inconspicuous towards the lower portion of lorica; in the optical section of wall the successive turns of the helicoidal band are also more difficult to distinguish, not (or only indistinctly) overlapping.

Is also very similar to *Favella ehrenbergi* var. *claparèdei*; thickness of wall, however, not so great as in *F. ehrenbergi* and varr.

Dimensions about as in the preceding species, but lorica generally shorter: length 196 μ—272 μ, diameter of mouth 90 μ, lower maximum of diameter less pronounced or wanting. Thickness of wall 4 μ—5 μ, "annuli" frequently numerous and narrow (low).

Occurred at Naples together with the preceding species and the two forms of *Favella ehrenbergi* mentioned. I saw no intermediate forms. It was present in greater numbers than *C. annulata*.

6. COXLIELLA FASCIATA (Kof.) Laackm. (Fig. 86 p. 73).

Laackmann 1911 p. 455. Cyttarocylis fasciata Kofoid 1905 p. 297, pl. XXVI figs. 6, 7; C. (Coxliella) fasciata var. procera Brandt 1906 p. 20, pl. 28 figs. 7, 9; 1907 p. 268; Cyttarocylis (Coxliella) helix Entz jun. (p. p.) 1909, pl. X fig. 3.

Sts. 14; 182 (545 m. wire), 206 (0 m., 1945 m. wire), 223 (1950 m. wire), everywhere only single, or in part incomplete, individuals.

Lorica elongated and narrow, very narrowly conical, frequently widening somewhat towards the mouth, below more rapidly constricted to a but slightly differentiated, not distinctly offset caudal prolongation of almost equal width, obtuse at the end and more like a narrowed and very elongated lower portion of the lorica proper. "Annuli" conspicuous, numerous, above, as well as below, more narrow (low), narrowest close to the mouth, broadest about at the lower $^1/_3$ (of length), here almost as broad as wide. In the optical section the "annuli" in the lower portion of lorica are more or less concave outwards, and slightly overlapping. Thicknes of wall somewhat increasing above. A relatively distinct "*Cyttarocylis*-structure" present, of secondary "prismatic elements" in one layer between the lamellæ.

Length (of the figured specimen) 374 μ, diameter of mouth 68 μ, thickness of wall 3 μ—4 μ.

This beautiful and easily recognized warm-water species was very rare in the Mediterranean, generally only present in very deep layers. It is scarcely indigeneous here; the loricæ were also but seldom uninjured (only at sts. 182 and 206, in deeper layers).

The dimensions given by Kofoid (l. c.), 520 μ × 100 μ are probably too great, presumably on account of an error as to the magnification. His figure (6), with the magnification stated (490), gives 270 μ × 50 μ, answering to var. *procera* Brandt (l. c.), a "variety", only established in consequence of the different dimensions (see also Laackmann l. c.).

Outside the Mediterranean known from a few localities in the Atlantic (German South-Pole Expedition $^{25}/_8$ and $^{26}/_8$ 1903, west of South-Africa; Sargasso Sea, about 32° N 44° W, and far south-east of Nova Scotia, as well as far south of Cape Farewell (Brandt l. c.) noted by Biedermann(?)). Also in the Pacific: off San Diego, 700 m.—0 m., Kofoid l. c.; New Pomerania, Brandt l. c.

7. COXLIELLA HELIX (Clap. et Lachm.) (Fig. 87 p. 73).

Tintinnus helix Claparède et Lachmann 1858 p. 206, pl. VIII fig. 8. Tintinnopsis helix Daday 1887 p. 562; T. annulata? Daday 1886, p. 496, pl. 25 fig. 15, 1887 p. 550, pl. 19 fig. 17. Tintinnus fistularis Möbius 1887 p. 120, pl. 8 fig. 38. Cyttarocylis helix Jörgensen 1899 p. 38; C. (Coxliella) helix Brandt 1906 p. 20, 1907 p. 213. Not Coxliella helix Entz 1909 pls. X—XII.

Sts. 109, 116, 134 (0 m.), 154, 169, 170 (0 m., in rather great numbers; 20 m.—0 m., 80—20 m., 200 m.—85 m.), Constantinople, 172 (0 m., 17 m.—0 m., 200 m.—51 m.), 173, 174, 175 (0 m., 30 m. wire, 350 m. wire, 1150 m. wire), 178 (in greater numbers), 179, Naples, 210.

Lorica narrow, of rather great length, generally of equal diameter throughout, sometimes very slowly narrowing in a downward direction, rarely somewhat widened below to a very slightly pronounced maximum diameter in the lower $^1/_3$, towards the lower end rather rapidly and conically narrowed to an offset, evenly narrowing and acute caudal prolongation, rather thick at its base, straight, or frequently

oblique or more or less flexuose. Lorica with more or less scattered "foreign" bodies, mostly shining, angular, pieces, sometimes also shells of diatoms or other very small organisms. Wall with two distinctly developed and separated lamellæ, at any rate in upper half, throughout formed by a helicoidal band with numerous turns which are generally very distinct, being visible on the longitudinal section as far as the caudal prolongation, sometimes also farther down, where the foreign bodies mostly are more numerous, ceiling the helicoidal spire. Very varying.

Length of lorica proper usually 170 μ—250 μ, exceptionally 85 μ—417 μ, of caudal prolongation 34 μ—60 μ, exceptionally up to 196 μ; diameter of mouth usually 47 μ—55 μ, but varying from 38 μ to 64 μ, sometimes a secondary maximum of diameter below, up to 77 μ. "Annuli" in the upper $^1/_3$ sometimes very narrow (low) and numerous. Structure of wall very varying; outside usually distinct to coarse "secondary" meshes, with or without(?) finer "primary" ones, are visible.

Caudal prolongation frequently injured, open at the end, or partly also laterally (unilaterally). As in *Tintinnopsis aperta* Bdt. and *T. fracta* Bdt. this is most probably due to the brittlenes produced by certain preserving fluids.

I have mentioned above that certain forms or species of *Tintinnopsis* seem to approach *Coxliella helix* in a degree which may make it very difficult to distinguish between them. This is particularly the case with the form which I have above named *T. lindeni*; in most cases, *Coxliella helix* will be easily distinguished by the very distinctly double wall and the more conspicuous helicoidal spire. Here, and probably in all cases, the latter is due to development and superposition of new turns of the helicoidal band. Close to the mouth they are young and low, but will develope to a certain size, which is nearly always greatest somewhat above the caudal prolongation, being very small towards the mouth. In the double-walled loricæ the border line between the turns is always much more distinct than in single-walled, probably because a coalescence of the parts in contact is difficult, when one of them is already developed into a firmer lamella. Brandt (1907 p. 217) has another interpretation of the phenomenon, explaining it as a development of a supporting rib (Verstärkungsleiste) in the wall. (Compare above pp. 8, 30).

This species only occurred very sporadically and sparsely in the Mediterranean, was, however, present everywhere in the Black Sea region, sometimes in greater numbers. Otherwise known from the coasts of the North Sea, in autumn extending into the Skagerrack, the Cattegat and the western and southern regions of the Baltic, according to Brandt also to the south-western coast of Finland. Probably also present on warmer coasts; is, however, easily confounded with species of *Tintinnopsis*.

If synonymous to *Tintinnopsis annulata* Dad., as supposed by Brandt (l. c.), it was already stated for Naples in 1886, at any rate in 1893 by Apstein. *Coxliella helix* Laackm. (1913) from the northern Adriatic presumably is partly this species, partly (my) *T. lindeni* above (compare that species). It is — like the species of *Tintinnopsis* — a neritic form, indigeneous on the Mediterranean coasts.

CLIMACOCYLIS n. gen.

Lorica of a rather soft or somehow jellied consistence, generally broadly tubular, with or without a large, more or less funnel-shaped dilation below where usually (?) widely open. Wall as in *Coxliella* formed by a single helicoidal band which is, however, provided outwards with a strongly protruding, coarse rib, running about in the middle of the band, parallel to its borders. Structure of wall a coarse and obvious "*Cyttarocylis*-structure" of large "secondary" primatic elements in a single layer between the well developed and separated lamellæ.

CLIMACOCYLIS SCALARIA (Bdt.) (Fig. 88).

Cyttarocylis (Coxliella) scalarius Brandt 1906 p. 7 pl. 21 fig. 15, pl. 26 figs. 4—6, pl. 27 figs. 1—3; 1907 p. 264. *Coxliella scalaria* Laackmann 1911 p. 455.

Sts. 38, 60, 66, 68; 80, 92, 98, 126 (275 m. wire), 129 (1100 m.—0 m.), 152 (250 m. wire, 950 m. wire), 156 (250 m. wire), 160 (0 m., 100 m.—30 m., 200 m.—100 m.), 163 (80 m.—0 m.), 182 (545 m. wire), 189 (945 m. wire), 194 (0 m., 1145 m. wire), 199 (200 m.—80 m.), 206 (1945 m. wire), 209 (1945 m. wire), 217, 218, 220, 223 (0 m., 1950 m. wire), 229, 231 (1145 m. wire).

Concerning the constitution of lorica, see the generic diagnosis.

Animalcule unknown. The rather soft loricæ of a very pallid appearance, easily overlooked (in water and glycerine). They are obviously but slightly heavier than water and, on account of the remarkable, outward, helicoidal rib, apparently strictly connected with or somehow fettered to the surrounding water, more so than most of other Tintinnids, so that they can only with difficulty be collected in the usual way. In the material of the "Thor" they were only present singly, though apparently not rare in warmer seas.

Fig. 88. *Climacocylix scalaria* (Bdt.); $^{350}/_{1}$. St. 60.

On the summer cruise this species was already met with in the Bay of Biscay, and afterwards from the Bay of Cadiz sporadically throughout the Mediterranean, until st. 182 (Euboea), but east of the Baleares only met with at two stations at the very surface, otherwise only at deeper levels. It was throughout more frequent in deeper layers than at the surface, being present at 13 of the 22 Mediterranean stations for deep water samples.

In winter, however, it was very rare in the (surface of the) Mediterranean, only noted for two stations (just inside the Straits of Gibraltar, and near Sardinia).

An immigration into the Mediterranean from the west seems to take place in September, the species being present in the Bay of Cadiz as well as near the African coast. In June it was very rare in the Bay of Cadiz and not observed in the Atlantic Current along the African Coast; if it enters at this season it must have passed over to deeper levels in the Alboran Sea. In winter there was no indication of the species getting in.

Otherwise it is widely distributed in the tropical and subtropical regions of the Atlantic, in many places in greater numbers, particularly in the tropical zone (Hensen 1911). It is met with altogether from 27° S to 43° N in the Atlantic, and, in addition, is known from Madagascar (Brandt l. c.), and farther south-east (Laackmann l. c.), far west of the south-west coast of Australia (33° S 97° 20′ E, S/S Tasmanic, capt. Håkonsson, May 1910), and from New Pomerania and Cook-Straits in the Pacific (Brandt l. c.).

Was first reported from the Mediterranean by Brandt l. c. (from Messina, taken by Lohmann). It probably gets occasionally in from the Atlantic, but is perhaps present in deeper layers all the year.

CYTTAROCYLIS Fol (emend. Laackm.).

Wall of lorica with well developed and separated lamellæ. Structure of wall coarse, "secondary" meshes, belonging to a — nearly everywhere — single layer of prismatic elements between the lamellæ; in addition a more or les distinct "primary" reticulation is present (of similar, only much smaller, prismatic elements (?)). In the optical section of wall a — mostly — single layer of cross-lines are seen (side walls of prismatic "secondary" elements). Wall not "annulated", but provided with a more or less spreading to erect, broadly collar-shaped oral rim, here called the "collar", limited from the lorica proper by an inwards protruding, sharp rib.

The animalcule has repeatedly been reported to have many nuclei, like others of the genera

provided with a "collar", but in contradistinction to most genera of Tintinnids. It needs, however, further investigations as to whether there is not, also in this genus, a normal stage with two macro- and two micronuclei, the multinuclear stages being perhaps connected with a development of "spores".

1. CYTTAROCYLIS CASSIS (Hck.) Fol. (Fig. 89).

Fol 1881 p. 22, pl. I fig. 6; 1884 p. 55, pl. IV fig. 6, pl. V fig. 10. *Dictyocysta cassis* Haeckel 1873 p. 563, pl. XXVII figs. 2, 3.

Sts. 10, Port Alice, 14, 20, Taormina, 23, 25, 26, 28, 29, 33, 36, 38, 39, 42, 66, 68, 69; 92, 126 (200 m.—100 m., 500 m.—120 m., 275 m. wire), 129 (100 m.—0 m., 600 m.—0 m., 1100 m.—0 m.), 132 (600 m.—195 m.), 134 (125 m.—75 m., 200 m.—125 m.), 152 (950 m. wire), 182 (545 m. wire), 186 (245 m. wire), 187 (190 m.—100 m.), 189 (945 m. wire), 199 (200 m.—80 m., 945 m. wire), 206 (1945 m. wire), 209 (200 m.—85 m., 1000 m.—200 m.), 213, everywhere singly or very scarce, at st. 126 (200 m.—100 m.) several specimens.

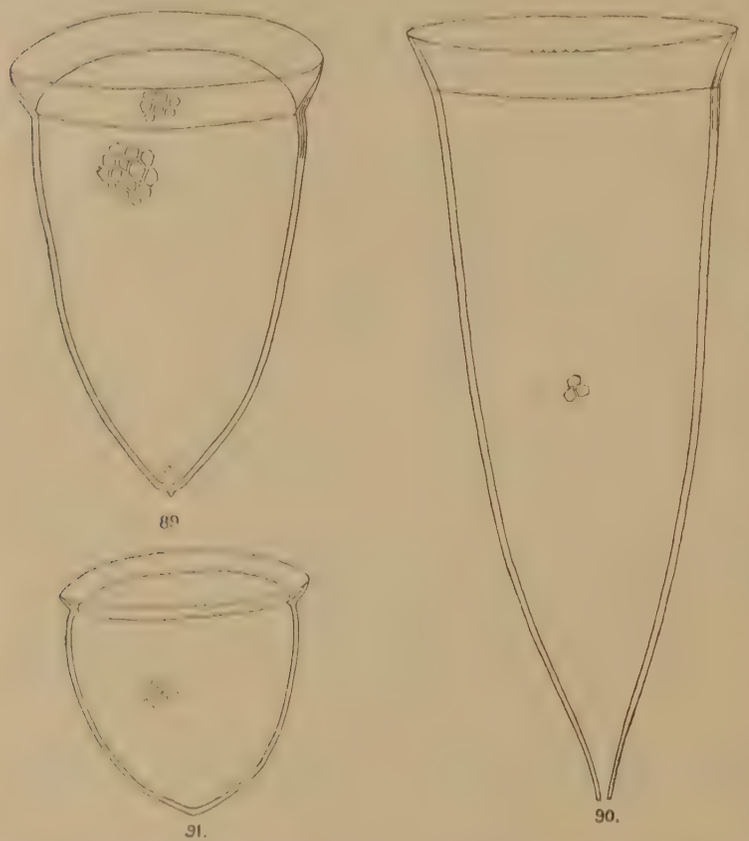


Fig. 89. *Cyttarocylis cassis* (Hck.) Fol; $^{350}/_{1}$. Fig. 90. *Cyttarocylis cassis* (Hck.) Fol, var. magna Bdt., $^{350}/_{1}$. St. 182, 545 m. wire. Denticles of rim only suggested. Fig. 91. *Cyttarocylis encecryphalus* (Hck.) Kof. $^{350}/_{1}$. Taormina Denticles of rim only suggested.

Lorica of greater length than width, below the suberect or somewhat spreading, outwards usually slightly convex, oral rim almost cylindrical for a short distance, then slowly and conically narrowing about to the lower $^{1}/_{3}$, then again more rapidly conical towards the very end which is usually more obtuse and most frequently provided with a mamilla, obtuse or acutish. Upper border of oral rim generally irregularly and slightly denticulated. Meshes with faintly elevated, rather thin walls, polygonal, or somewhat rounded with walls thickened at the corners, in the upper portion of oral brim 8 μ—9 μ, in the middle of lorica 6 μ—7 μ, towards the lower end 2 μ—3 μ.

Length 179 μ—196 μ; diameter of mouth 124 μ—145 μ, of the base of oral rim at the constriction 99 μ—128 μ. Lower end of lorica varies from obtuse, or sometimes truncate — then usually with a mamilla — to acute, sometimes with an open, fine channel. The structure is also varying, though on lorica proper rather uniform, on oral brim of more unequal meshes.

The distribution in the Mediterranean was very characteristic, recalling that of subtropical *Ceratia* and *Dinophysiaceæ*. In winter it was present in the Bay of Cadiz and in the middle regions of the Mediterranean, especially in the Tyrrhenian Sea, but very scarce or singly, only at st. 28 in somewhat greater numbers. In summer it had disappeared from the surface — only noted for a single station (213) in the Catalonian Sea — but was present at most of the stations for deep water samples (at 13 of 22

in the Mediterranean), apparently at a rather great depth, 100 m. to 200 m. The loricæ were nearly always empty; remains of the animalcule only noted for st. 134, 125 m.—75 m.

As already pointed out by BRANDT (1907 p. 195) the dimensions given by HAECKEL (l. c.) are considerably smaller than otherwise found, on account of which he considers HAECKEL's form, the main species, to be very rare. As, however, the rich material of the "Thor" does not contain a form of such small dimensions (less than $^2/_3$ of the usual) it may be considered almost certain that those small dimensions are owing to an erroneous note, probably a magnification of 400 (as in his figure of *Codonella orthoceras*) instead of 600 (as stated). Nor do I think we should attach too much importance to his figuring the lower end of lorica as acute — also in DADAY (1887 pl. 21 fig. 3) who gives the correct dimensions — such forms being very slightly different from the usual ones. In my opinion the usual Mediterranean form — as described above and answering to var. a BRANDT (1906/7 p. 195, pl. 34 figs. 2, 4, 5) — should be considered the main species, to which, if desirable, may be added a forma *acuta*. The similar var. *conica* Bdt. (p. 196, pl. 34 fig. 6, pl. 35 fig. 8) seems also to be only an accidental, more obtuse, form. On the other hand var. *magna* Bdt. (pl. 34 fig. 3, pl. 35 fig. 3) is presumably a separate species (see below), probably also var. e Bdt. (pl. 35, figs. 4, 5). This latter I have not yet seen.

Var. **magna** Bdt. l. c. p. 196 (Fig. 90, p. 78).

Lorica more elongated than in the other forms, as well as larger. Lateral outlines — of lorica proper together with the oral rim, which is very slightly or not at all outwardly directed — almost straight to below the middle, whence slightly convex, and then somewhat soncave towards a protracted, rather offset, lanceolate point, frequently with a narrow channel opening at its end. Meshes of the oral rim unequal in size, polygonal, up to 9 μ, in the middle of lorica about 5 μ—7 μ and rather regular and equal-sized to the lower end.

Length 314 μ—332 μ, diameter of mouth 140 μ—162 μ.

Upper border frequently rather regularly denticulated.

Very rare in the material of the "Thor", only noted for one station: 182, 545 m. wire, a couple of individuals.

The main species is a relatively frequent warm-water species, of a wide distribution in the Atlantic, but generally present in small numbers. It is known from the south point of Africa (LAACKMANN 1911) to 39° N in the Florida Current, far south-east of Nova Scotia (BRANDT 1907) and seems to be on the whole rather common in this large area; exceptionally it extends to 46° N 42° W (where I took it singly in April 1910). Otherwise known from the Indian Ocean (German South-Pole Exp. $^{15}/_5$ 1903, far south-east of Madagascar, LAACKMANN 1911) and from the Pacific (south-west and south of Australia and New Zealand, BRANDT 1907). KENT (1882) reports it from Falmouth, and AURIVILLIUS (1898) from the Swedish coast in the Skagerrack (only once taken; in both cases the records may perhaps apply to the following species).

Var. *magna* is much rarer; according to BRANDT (l. c.) it is known from the Sargasso Sea, the Florida, the North Equatorial and the Benguela Currents, New Zealand, Tonga Islands and the sea south of Australia. I have not listed it as a separate species, only because there is a form, var. d Bdt. (l. c. p. 197, pl. 35 figs. 1, 2) which in size, as well as in shape, seems (to me) to be intermediate to the main species, answering to the latter in structure.

Cyttarocylis cassis was first recorded for the Mediterranean by HAECKEL (1873 and before) from Messina, afterwards by FOL (1881) from Villefranche, by DADAY from Naples and by ENTZ jun. (1904) from the northern Adriatic, together with var. *magna*.

2. CYTTAROCYLIS EUCECRYPHALUS (Hck.) Kof. (Fig. 91, p. 78).

Kofoid 1912 p. 353. Sethocephalus eucecryphalus Haeckel 1887 p. 1298, pl. 56 fig. 13. Cyttarocylis cassis var. plagiostoma Daday 1887 p. 581, pl. 21 fig. 13. C. plagiostoma Brandt 1906 p. 22, pl. 35 fig. 7, pl. 36 fig. 12, 1907 p. 198, incl. var. a p. 199, pl. 36 figs. 1, 4, 8, and var. b p. 199, pl. 36 fig. 7.

Sts. 11, Port Alice, 14, 20, Taormina, 23, 25, 26, 27, 28 (several specimens), 29, 31, 33, 38, 39, 40, 60, 62, 66 (several specimens), 68, 69; 126 (200 m.—100 m., 500 m.—120 m., 275 m. wire), 129 (80 m.—0 m., 600 m.—0 m., 1100 m.—0 m.), 134 (125 m.—75 m.), 152 (250 m. wire, 950 m. wire), 156 (250 m. wire, 950 m. wire), 160 (200 m.—100 m.), 182 (545 m. wire), 186 (245 m. wire), 187 (190 m.—100 m., 945 m. wire), 189* (945 m. wire), 194 (0 m., 1145 m. wire), 199 (945 m. wire), 206 (1945 m. wire), 223 (1950 m. wire), 234 (200 m.—95 m.); always singly or very scarce, if not otherwise mentioned.

Lorica generally of greater width than length, roundedly campanulate; the oral rim narrower than in the preceding species, always rather spreading. Lorica at the lower end rounded, or usually more or less distinctly broad and conical, often very slightly protracted, but at the very end obtuse, frequently showing a very narrow, open channel, axial, or somewhat laterally situated. Structure of irregular meshes, very unequal in size, in the oral brim and near to the constriction usually some large ones, 8 μ—10 μ, otherwise mostly of very different shape and size.

Length 94 μ—113 μ, diameter of mouth 113 μ—140 μ; oral rim usually only 11 μ—13 μ broad (long), often regularly and closely denticulated.

The animalcule seems to be unknown.

Is a more frequent species than the preceding one, but has a similar distribution, in the Mediterranean, as well as otherwise. The distribution in the Mediterranean, during the winter as well as during the summer cruise, was very similar to that of the preceding species; in summer it was only taken at one Mediterranean station at the surface (st. 194), whilst present in deeper layers at 14 of the 22 stations where such samples were taken in the Mediterranean proper, and at a corresponding depth to that in which the preceding species occurred.

In the Atlantic it is rather common from 32° S, west of South Africa, to 40° N in the Florida Current, and to 43° N west of the north-western coast of Portugal. It is present in many places in greater numbers, especially in the Sargasso Sea (Brandt l. c.). Is also known from the Indian Ocean (south-east of and near Madagascar, Red Sea, Somali Coast, Ceylon, Bay of Bengal, south-west of Australia) and from the Pacific (south of Australia, near New Zealand, New Pomerania and Tonga Islands). (Mostly according to Brandt l. c., in part to Laackmann 1911 and my own samples).

It was detected in the Mediterranean by Daday, at Naples, but is — strange to say — afterwards only reported from the Mediterranean by Brandt. It is undoubtedly a well defined species, though rather closely allied to the preceding.

In the distribution of these two species no direct indications of an immigration into the Mediterranean from the west are seen. They are apparently true (indigeneous) Mediterranean species, having in common with other subtropical ones the peculiar occurrence, only in winter at the surface, withdrawing to deeper levels in summer. Such species, having large and relatively heavy loricæ, may, however, normally belong to layers below the surface. *Cyttarocylis cassis* was present at st. 92 in June, and may perhaps have got in through the Straits, passing over to deeper layers in the Mediterranean. An occasional invasion below the surface is very probable (in both species), but would not be perceived from the contents of the samples.

The generally scarce occurrence in the deep water samples seems to be suggestive of a mere passing over to deeper levels in summer, without any following swelling up in numbers, only with an occasional renewal of stock through immigration into the Mediterranean from the Atlantic.

DICTYOCYSTA Ehrb.

Lorica short and wide, more or les campanulate, having an upper, more or less distinctly offset and almost cylindrical "collar", consisting of a single or double row of large, rectangular or oval "windows", separated by more or less thin and columnar intermediate beams. Lorica proper below the collar somewhat swollen, roundish, double-walled and with different structure (in different species), consisting of smaller and larger meshes and the usual fine, primary structure. No caudal prolongation, nor denticles at the mouth; helicoidal constitution of wall wholly wanting.

Animalcule reported to have 8 macro-nuclei and 20 membranelles (Daday 1887), according to Entz jun. 1909 3—11 macronuclei and 18 membranelles; there is also an apparatus for shutting the oral aperture.

1. DICTYOCYSTA ELEGANS Ehrb. (Fig. 92 p. 82).

Ehrenberg 1854 a, p. (54 and) 238; 1854 b, pl. XXXV A XXIV fig. D. Brandt 1907 p. 65, pl. 1 figs. 7, 8, pl. 2 fig. 12, incl. var. a p. 66, pl. 1 fig. 9, pl. 2 figs. 4, 7, var. b p. 67, pl. 2 fig. 8, pl. 4 fig. 4 and var. c p. 67, pl. 2 fig. 1.

Sts. 10, 12 (several), 14, 16, Naupaktos, 23, 26, 28, 29, 31 (several), 33, 35, 38; 79, 80 (abundant and predominating), 81 (100 m. wire), 92, 93, 94, 95, 98, 99, 116, 120, 122, 126 (275 m. wire), 128 (100 m.—0 m.), 129 (600 m.—0 m., 1100 m.—0 m.), 134 (200 m.—125 m.), 152 (250 m. wire, several; 950 m. wire), 156 (250 m. wire), 175 (350 m. wire, 1150 m. wire), 178, 182 (545 m. wire), 186 (0 m., 245 m. wire, 1145 m. wire, and in Salpæ), 187 (945 m. wire), 189 (945 m. wire), 190, 194 (0 m., 1145 m. wire), 199 (200 m.—80 m.), 200, 206 (1945 m. wire), 209 (200 m.—85 m., 1000 m.—200 m., 945 m. wire, 1945 m. wire), 210, 211, 228 (0 m.), 234 (100 m.—25 m., 200 m.—95 m., 700 m.—200 m). Scarce or singly if not otherwise mentioned.

Lorica — in this and the next two species — provided with a collar of large, angular windows, whilst the lower portion, lorica proper, shows a lattice-work of larger and smaller meshes, without transition to the large ones of the collar. In the present species the collar consists of a double row of large windows.

Highly varying in shape and structure. A particularly beautiful and frequent form is the following,

var. **speciosa** n var. (Fig. 93 p. 82).

Dictyocysta templum var. disticha Jørgensen 1899 p. 40 p. p. D. elegans "p. p. Møbius" Biedermann 1892 p. 9, pl. I fig. 2. D. elegans Brandt 1907, pl. 1 fig. 7.

Collar strongly offset, in shape as well as structure. Below the collar the lorica is abruptly dilated, the lateral outlines bulging, then conically converging towards an obtuse, dome-shaped lower end. A circle of large, oval windows are found about the middle of the lorica proper, close below its greatest diameter; below these larger windows mostly a circle of similar, somewhat smaller, or only some few scattered ones.

Length about 89 μ, collar slightly shorter than lorica proper. Diameter of mouth 42 μ—51 μ, maximum diameter of lorica proper 47 μ—59 μ.

This form is exceedingly similar to *D. lepida* and perhaps not always distinguishable from this latter species. (Compare Biedermann l. c., as well as the following species).

Brandt (l. c.) considers this form to be the main species, presumably for the following reason. Biedermann (l. c., p. 11 pl. III fig. 3) gives a figure of *Dictyocysta mitra*, naming it *D. elegans* s. str. Ehrenberg. Accordingly, Brandt (l. c. pp. 63, 65) refers the figure in Ehrenberg (1854 b l. c.) to *D. mitra*, in contradistinction to Ehrenberg's diagnosis of the species (1854 a). This must, however, be erroneous, the shape of the figure (in Ehrenberg) quoted already obviously showing a species different from *D. mitra*,

with two rows of large, angular windows. Besides, the figure in question shows, by dots, the very small meshes below the collar and elsewhere which are absent in *D. mitra*.

Decisive as to the choise of main species should be, either the figure quoted (in J. Müller 1841 p. 233, pl. 6 fig. 6) 1854 a, which represents the present species, or — according to Brandt (l. c.) — the following, or the figure, afterwards (1854 b) given by Ehrenberg himself. Both figures mentioned must in Ehrenberg's time be considered to represent one and the same species; yet there should be no doubt as to the choise between these figures, the first representing a form which only here below, for the first time, is considered specifically different from the present species.

In short, it seems to be most correct to choose as main species a form answering somehow to the figure in Ehrenberg (1854 b), i. e. a form in which the collar is offset from the lorica only as to structure, not as to shape (lorica not bulging). Such forms do occur, are, however, very varying, particularly in structure, this latter being on the whole rather irregular, whilst var. *speciosa* is very well defined, both in structure and shape.

In winter *D. elegans* was widely distributed in the middle regions of the Mediterranean, but was not observed west of Sardinia; var. *speciosa* was frequent. In summer the species was already met with

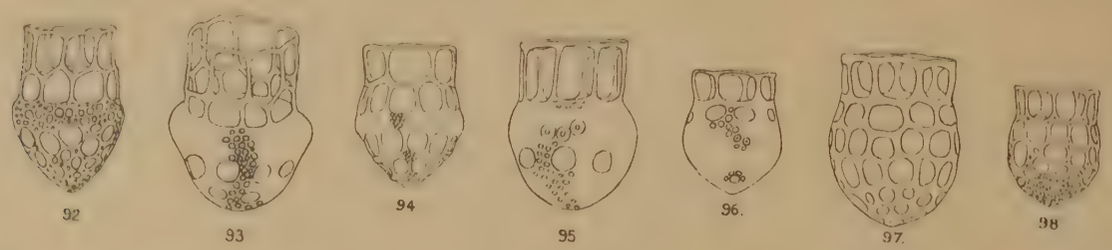


Fig. 92. *Dictyocysta elegans* Ehrb. a small specimen of f. *varians* n. f., from st. 80; $^{350}/_{1}$. Fig. 93. *Dictyocysta elegans* Ehrb., var. *speciosa* n. var.; $^{350}/_{1}$. Naupaktos. Fig. 94. *Dictyocysta mülleri* (Bdt.) n. sp.; $^{350}/_{1}$. St. 152, 950 m. wire. Fig. 95. *Dictyocysta lepida* Ehrb.; $^{350}/_{1}$. Naupaktos. Some coccoliths on the broader part of the lorica. Fig. 96. *Dictyocysta entzi* n. sp.; $^{350}/_{1}$. St. 26. Fig. 97. *Dictyocysta mitra* Hck.; f. *obtusa*, $^{350}/_{1}$. Messina $^{8}/_{3}$ 1911. Fig. 98. *Dictyocysta mitra* Hck., var. *minor* n. nom. var.; $^{350}/_{1}$. St. 199, 200 m.—80 m.

in the Bay of Biscay in June, partly abundant, and was also taken in the Bay of Cadiz, as well as just inside the Straits of Gibraltar. In the Atlantic Current along the coast of Africa it was lacking, and was farther on altogether very rare at the surface, but very frequent in deeper layers, being found at $^{2}/_{3}$ of the total number of Mediterranean stations where deep water samples were taken. It was stated to be present as far as into the Sea of Marmora.

The most frequent form in the west was var. *speciosa*, which also occurred in the northern Jonian Sea, and at st. 209 in the Catalonian Sea, below 85 m.

Forms answering to the main species — as defined by the figure in Ehrenberg (1854 b) — with lateral outlines passing evenly over from collar into lorica proper, were very rare or almost absent in the Mediterranean; corresponding forms were seen sparsely at sts. 14 and 80. Another form, f. *varians* (fig. 92), usually considerably smaller than var. *speciosa*, only slightly bulging below the collar, as well as with irregularly scattered "windows" in more than two circles on lorica proper, and with altogether less regular structure (of lorica), was frequent throughout the Mediterranean. Length 66 μ—79 μ, collar slightly shorter than lorica proper, maximum diameter of the latter 47 μ—59 μ, not much greater than at the mouth.

Dictyocysta elegans otherwise has its chief area of distribution in the northern Atlantic, being abundant in the cooler regions, particularly from the border line between the Labrador and the Florida Currents until near Iceland. In the north it extends to beyond 70° in the Norwegian Sea, in the south the border line of distribution is as yet rather indefinite, the species being difficult to distinguish with certainty from the two following species.

It was first reported for the Mediterranean by Imhof (1886 a), from Venice (*D. "templum* var. *mülleri"*), afterwards by Lohmann (1903) from Syracuse, by Entz jun. (1904) from the northern Adriatic (figs. 24, 26—29, as *D. "templum"*, 1909 as *D. elegans*) and by Brandt (1907) from Messina (taken by Lohmann).

2. DICTYOCYSTA MÜLLERI (Bdt.) n. sp. (Fig. 94 p. 82).

D. elegans var. (e) mülleri Brandt 1907 p. 67, pl. 2 figs, 2, 5, 6, pl. 4 fig. 3. J. Müller 1841 p. 233, pl. 6 fig. 6 (?).

Sts. 152 (250 m. wire, several; 950 m. wire), 153, 156 (250 m. wire, 950 m. wire), 182 (545 m. wire), 186 (1145 m. wire and in Salpæ, 187 (945 m. wire), 189 (945 m. wire), 192 (945 m. wire), 209 (200 m.—85 m., several; 1000 m.—200 m., 945 m. wire), 211.

A beautiful and well defined species, similar to *D. elegans*, but having only 6 "windows" in the upper row of collar, a slight constriction between this row and the next, and the lateral outlines passing evenly over from collar into lorica proper. Also smaller than the preceding species.

The collar is conically dilated from the middle upwards as well as downwards, having 6 almost square windows in the upper row, partly broader than long, separated by strong beams; in the next row there are 7 or 8, somewhat smaller windows. Lorica proper has its maximum diameter somewhat below the collar, which is only in structure definitely limited from the lorica proper; the latter has round the middle 8 to 10 oval windows of somewhat unequal size, and below these a similar circle of smaller ones, les regularly developed. Above the middle row of windows, and partly between the latter, a more or less coarse structure of "secondary" meshes is found, partly small and rather regularly developed, without windows, partly greater, of rather unequal size and with a single or double circle of rather small, oval to roundish windows. Lorica proper of almost the same shape as in *D. elegans* f. *varians*, but below with a more distinct, though obtuse, point.

Length 54 μ—62 μ, collar usually slightly longer than lorica proper; diameter of mouth 38 μ—42 μ, at the middle of collar 34 μ—40 μ, maximum diameter of lorica 43 μ—45 μ.

Was very rare and always scarce or only present singly in the Mediterranean, only met with in summer and in the Eastern Mediterranean and the Catalonian Sea, also only in deeper layers save at one station (153) on the coast of Barca, and at one near Barcelona.

Up to the present only known from scattered localities in the warmer regions of the Atlantic, from west of South Africa in the Brazil Current (German South-Pole Exp. $^{18}/_{8}$ 1903) about $28^{1}/_{2}^{\circ}$ S $4^{1}/_{2}^{\circ}$ E (Laackmann 1911) to the Sargasso Sea, about 31° N 48°—50° W (Brandt 1907). Also in the Indian Ocean, south of Madagascar (Brandt l. c.).

3. DICTYOCYSTA LEPIDA Ehrb. (Fig. 95 p. 82).

Ehrenberg 1854 a, p. 237; Kofoid 1915 p. 64. D. templum Haeckel 1873 p. 564, pl. XXVII fig. 6; Entz sen. 1885 p. 208, pl. 14 figs. 18—21, 23; v. Daday 1887 p. 585, pl. 21 figs. 8, 9; Brandt 1907 p. 68, incl. varr. a—c, f, pl. 3 figs. 1—4, 7—9, pl. 4 figs. 1, 2, 5, 6, excl. varr. d, e, g, h.

Sts. 10, 11, 12, 14, 15, 16, Naupaktos, 18, 20, Taormina, off Naples, 23—29 (abundant), 31 (likewise), 33 (likewise), 35, 36 (predominant and abundant), 38 (abundant), 39 (numerous), 40, 42, Galita, 45, 55, 57—59, 60 (many), 62, 66, 68, 69 (many); 80, 81 (100 m. wire), 87, 89, 91, 92, 95, 118, 119, 120 (abundant), 122, 125, 126 (0 m., 200 m.—100 m., 275 m. wire), 128 (100 m.—0 m.), 129 (80 m.—0 m., 600 m.—0 m., 1100 m.—0 m.), 132 (600 m.—195 m.), 135, 138, 152 (250 m. wire), 186 (0 m., 245 m. wire, 1145 m. wire, and in Salpæ), 189 (945 m. wire), 194 (0 m,, 1145 m. wire), 199 (945 m. wire), 200, 204 (0 m., 945 m. wire), 206 (1945 m. wire), 209 (1000 m.—200 m., 945 m. wire, 1945 m. wire), 234 (25 m.—0 m., 100 m.—25 m., 200 m.—95 m.).

Lorica very similar to that of *D. elegans* f. *varians* and — particularly — var. *speciosa*, but differs in having only a single row of large windows in the collar. The latter is cylindrical, or mostly slightly widened in an upward direction, with 6, 7 or 8, exceptionally 5 or 9, rectangular — rarely shorter to

nearly square — windows, separated by rather thin (narrow) to strong, almost straight, to outwardly more or less convex, beams, sometimes of an oblique direction in regard to the longitudinal axis of lorica. The latter always strongly offset from the collar, in shape as well as in structure, broadly dome-shaped (a slightly elongated hemisphere) widest somewhat below the collar, below almost rounded or faintly suggestive of being pointed; usually, about the middle a circle of mostly 8 (7 to 10) roundish or oval, but often irregularly developed, windows. Otherwise a "secondary" structure of usually coarse, more or less irregular and unequal-sized, polygonal meshes, frequently with a few or several, somewhat smaller, windows below the normal median ones, sometimes also with small, numerous and more or less irregularly scattered, windows on the upper broader portion of lorica proper. The "primary" structure mostly relatively coarse and obvious.

Highly varying in nearly all respects, though for the most part easily distinguished from the very closely allied *D. elegans*. There seems to be no other difference which holds good in all cases, beyond the single, or double row of windows in the collar, this being also the only difference between the specific diagnoses of Ehrenberg. This difference also sometimes fails, the lower row of windows being irregularly developed and partly wanting; transitional forms are, however, more or less rare, so that, for practical reasons, it may be of advantage to consider *D. lepida* as specifically different from *D. elegans*.

Length 64 μ—76 μ, of which lorica proper makes 40 μ—45 μ; diameter of mouth 42 μ—51 μ, maximum diameter below the collar 47 μ—48 μ.

A very remarkable and important form is

var. **coccolitholega** (Lohm.).

Dictyocysta coccolitholega Lohmann 1912 p. 205, figs. 1, 2, 1920 p. 230; D. templum var. d Brandt 1907 p. 71, pl. 2 fig. 10, pl. 4 fig. 7, var. e duplex p. 72, pl. 2 fig. 9.

Differs from the main species in wanting windows on lorica proper. The latter shows a rather uniform, very coarse structure of large, roundish, overlapping meshes, partly intermingled with smaller ones.

In living state the species has its lorica covered with coccoliths of different Coccolithophoridæ; Lohmann has stated to be present *Coccolithophora wallichi*, *C. pelagica* and *C. leptopora*.

D. lepida belongs to the most characteristic and important Tintinnids of the Mediterranean, being frequent in most regions of that sea. Compared with the very closely allied *D. elegans*, it is a more southern, thermophilous species; correspondingly, it was plentiful in the Bay of Cadiz in winter. I have also seen it from Straits of Gibraltar in Decbr. 1908 (S/S Sevilla, capt. Rød).

During the winter cruise it was common in the Tyrrhenian Sea, as well as in the Ligurian Sea, at the surface, frequently abundant, and was present throughout the route save in the Atlantic Current in the west, along the African coast.

During the summer cruise it had, on the whole, almost exactly the same distribution as *D. elegans*, all the way from the Bay of Biscay, only here, and in the Eastern Mediterranean, rare, in the latter region only taken at three stations. *D. lepida* did not extend farther in than to the west coast of Greece and to Barca, whilst *D. elegans* was present as far as into the Sea of Marmora.

This great accordance in distribution of both species in the Mediterranean is also in favour of considering *D. lepida* as only a variety of *D. elegans* (*Cleve* 1901 d, Biedermann 1892).

Var. *coccolitholega* was very rare in the Mediterranean; it was only seen, typically developed, at st. 120 in the northern Balearic. Forms intermediate to the main species, showing coccoliths between collar and median row of windows on lorica proper, about at maximum of diameter, were somewhat more frequent. The coccoliths disappeared in formaline, glycerine and on addition of acids, leaving a

similar, very coarse structure to that in BRANDT (l. c.) pl. 3 figs. 4, 5. Particularly frequent were round discs with a dot (pore) in the middle, presumably coccoliths of *Coccolithophora leptopora*.

In regard to the still obscure question as to formation of the loricæ, I think *Dictyocysta lepida* var. *coccolitholega* may afford excellent information. The structure of this form (cf. BRANDT 1906 pl. 2, figs. 9, 10) differs so essentially from that of the usual forms, that most authors certainly would consider this variety a well distinguished species. It is particularly striking that the usual middle circle of large windows is wanting.

Considering the way in which the "incrustation" of coccoliths on the outer side of the lorica has been produced, it seems impossible that the lorica was finished when the coccoliths were agglutinated, the structure of a finished lorica being presumably no more changeable. Any sort of symbiosis between the *Dictyocysta* and the Coccolithophorids seems therefore impossible, if these organisms are not captured at the very moment when the substance of the lorica is being secreted. More probably, it is only the shells, the coccoliths, which are imbedded in or agglutinated to the lorica, originated as fæcalia from captured and devoured organisms. Where the lorica has remained destitute of such coating, the usual structure has developed. I have seen specimens with few coccoliths, scattered round the widest portion of the lorica below the collar; in this case the usual circle of windows was present. The irregular, sometimes double structure of this upper portion of the lorica, below the collar, may be due to such an agglutination of coccoliths (cf. BRANDT 1906 pl. 1 figs. 7, 8, pl. 3 figs. 2—5).

Dictyocysta lepida is a rather common warm-water species, widely distributed in the Atlantic, all the way from 44° S (9° E., CLEVE 1901 a) to Iceland, in the South Equatorial Current abundant (Sept. 1889, see BRANDT l. c. p. 58). Also frequent in the Indian Ocean, in the south as well as in the north (CLEVE 1901 a, b, OSTENFELD and SCHMIDT 1901, BRANDT 1907, LAACKMANN 1911; in part according to my own samples). I have also seen it from 51°—53° S, of the west coast of southern South-America (the Melderskin, capt. JACOBSEN, June 1909, and the Alden, capt. KARS, January 1910) and from the west coast of Mexico, south of Californian Gulf (21° N, the Alden, Febr. 1910).

Var. *coccolitholega* and allied forms with coccoliths I have taken near the border between the Labrador and the Florida Currents, April 1910. A similar form is presumably also *D. templum* var. h LAACKMANN 1911 p. 434, pl. XLIX fig. 3, from the South Equatorial Current (German South-Pole Exp., 11th and 21st of Sept. 1903). LOHMANN's *D. coccolitholega* was taken in the Brazil Current, about 38° S 42° W, Aug. 1911.

D. templum was detected by HAECKEL at Messina (see HAECKEL 1873) and afterwards reported by FOL from Villefranche, by ENTZ sen. and by DADAY from Naples, by ENTZ jun. and by ZACHARIAS from the northern Adriatic, and by LOHMANN from Syracuse.

4. DICTYOCYSTA ENTZI n. sp. (Fig. 96 p. 82).

D. mitra ENTZ sen. 1885 p. 211, pl 14 fig. 22, not D. mitra Hck. D. templum var. g BRANDT 1907 p. 73, pl. 3 fig. 6 (a deviating form).

Sts. 11, 25, 26, 28, 29, 55; 189 (945 m. wire), everywhere singly.

A beautiful, small species, allied to *D. mülleri*, by ENTZ sen. referred to *D. mitra*, by DADAY (1887 p. 586) to *D. elegans*, by BRANDT to *D. lepida*: Shape of lorica characteristic, most similar to a short and wide *D. mitra*. Collar not distinctly offset, slightly and conically dilated towards the mouth, nearly always with 6, rarely but 5, in the form of BRANDT 7, windows in a single row, square, or somewhat transversely rectangular. Lorica proper rounded, below the collar widening evenly by evenly convex — or above conical — outlines, merging below to an angular, very obsolete, point. Minimum diameter (of upper half) at the transition of collar into lorica; just below there is mostly a row of rather distant, rarely more closely set, roundish or oval windows, 5 to 8 or 9 in number, in the latter cases sometimes forming a continuous

circle, strongly recalling the second one, from above, in *D. mülleri*. Below this more or less complete (second) circle of windows, one finds in *D. entzi* mostly a rather uniform, more or less coarse "secondary" structure of polygonal, roundish or oblong meshes, extending down to the very end, as well as to the broader interstices between the windows (of the second circle); there is, however, sometimes also a third circle of windows, irregularly developed as to shape, dimensions, number and situation, particularly numerous if there are many windows, close together, in the second circle. On the other hand, forms occur, having below the windows of the collar a rather uniform, very coarse, structure of polygonal, unequal-sized meshes without proper "windows".

Total length 45 μ—51 μ, of which the collar takes up 12 μ—15 μ; diameter of mouth 34 μ—43 μ, maximum diameter, about in the middle of lorica proper or above, rarely somewhat below, 40 μ—45 μ. The secondary meshes (below the windows) usually 3 μ—4 μ (rarely 2 μ or 5 μ), the windows of the second row about 11 $\mu \times$ 12 μ.

Varies in a similar way to *D. elegans* and *D. lepida*; the form mentioned, without windows of lorica proper, is analogous to *D. lepida* var. *coccolitholega*.

Very rare in the material of the "Thor", occurring from the south coast of Spain as far as the Jonian Sea, in the surface as a winter species. The variety mentioned, without windows on lorica proper, was taken at st. 55. I have myself taken it at 44° N 43$^1/_2$° W, far east of New Foundland, April 1910. Brandt's species (or form), showing very acute, distended spines at the mouth — by optical delusion? — was caught in the Sargasso Sea.

Entz sen. found this species at Naples, in Salpæ.

5. DICTYOCYSTA MITRA Hck. (Fig. 97 p. 82).

Haeckel 1873 p. 563, pl. 27 figs. 4, 5; v. Daday 1886 p. 497, pl. 25 fig. 16; Brandt 1907 p. 63, pl. 1, figs. 1, 2. pl. 2 fig. 11. D. elegans Biedermann p. p. ("s. str.") 1892 p. 11, pl. III fig. 3; v. Daday 1887 p. 586.

Sts. 10, 11 (several), Port Alice, 12—15 (abundant), 16, Naupaktos, 18, 20, Taormina, off Naples (many), 24 and 25 (abundant), 26, 27, 28 (many), 29, 31 a. 33 (abundant), 35, 36 (several), 38, 39 a. 40 (many), 42, 55—62 (singly), 66, 68, 69; 126 (500 m.—120 m.; 275 m. wire, abundant), 128 (100 m.—0 m., many), 129 (80 m.—0 m., singly; 600 m.—0 m., several; 1100 m.—0 m.), 132 (600 m.—195 m., several; 1090 m.—57 m.), 134 (75 m.—0 m.; 125 m.—75 m., several; 200 m.—125 m., 350 m.—185 m.), 152 (250 m. wire, 950 m. wire), 153 (singly), 156 (250 m. wire, 950 m. wire), 160 (200 m.—100 m., 1000 m.—200 m.), 163 (80 m.—0 m.), 179, 182 (545 m. wire), 186 (0 m.; 245 m. wire, in greater numbers; 1145 m. wire, and in Salpæ, many individuals), 187 (0 m., 190 m.—100 m., 945 m. wire), 189 (945 m. wire), 192 (0 m., 545 m. wire), 194 (0 m.; 1145 m. wire, several), 197, 199 (30 m.—0 m.; 200 m.—80 m., several; 945 m. wire), 200, 202, 204 (945 m. wire, abundant), 206 (1945 m. wire, several), 208, 209 (below 33 m., abundant), 210, 211. Scarce if not otherwise mentioned.

Lorica different from that of the other species in being a lattice-work of windows separated by rather broad beams without larger and smaller areas of "secondary" meshes. Such are only found singly here and there in corners between 3 or more, contiguous, windows, or near the lower end of lorica where also the windows are smaller; only in the var. *minor* such smaller meshes are more numerous in the lower $^1/_3$ of lorica.

Collar not or only indistinctly offset; nearly always, however, the upper row of windows, close to the mouth, consists of greater, more squarish meshes, forming an indistinct collar — often slightly widening in an upward direction — with a single row of windows, frequently somewhat constricted at its base. Lorica proper usually somewhat widening from base of collar towards the middle or somewhat above; below it is usually angularly acutish, more rarely distinctly acute, or rounded, with a very small, offset point or a tiny, obtuse mamilla.

The main species, according to Haeckel and to Brandt (l. c.), is not very broad, and only slightly dilated towards the mouth.

A very frequent form is the following.

f. **obtusa** n. f. (Fig. 97 p. 82).

D. mitra var. b Brandt (l. c.) p. 64, pl. 1 fig. 3, pl. 4 fig. 8.

Collar with much larger meshes than those of the next following row — about 17 μ, against 11 μ in the latter — obviously squarish, whilst those of the second and following rows are more rounded in the corners. The lorica is also usually shorter and wider than in the main species, being obtuse or rounded below, frequently ending in a small obtuse or acute mamilla.

Length 65 μ—74 μ, diameter 48 μ—51 μ; collar with 7, rarely 8 windows.

It is this form which manywhere in the Mediterranean is abundant, f. i. at st. 186 in the Jonian Sea, at st. 204 in the Balearic, and at st. 209 of the Catalonian Sea.

Very similar to the form mentioned, though on the other hand also a characteristic one, is

f. **dilatata** Bdt. (as var. a *dilatata*, p. 64, pl. 1 fig. 4).

Towards the lower end more pointed (acuminate) and distinctly acute, frequently also with a collar more distinctly pronounced, more dilated towards the mouth, and, on the whole, somewhat smaller dimensions.

Widely distributed, but always more or less scarce.

Much more different from the main species is

var. **minor** n. var. (Fig. 98 p. 82).

D. mitra var. c Brandt l. c. p. 64, pl. 1, figs. 5, 6.

Lorica shorter and proportionately wider than in the main species, in the lower $^1/_3$ with meshes of very unequal size, with many intermingled, small, "secondary", meshes.

Length 47 μ—53 μ, diameter of mouth 31 μ—34 μ, maximum diameter 36 μ—38 μ.

In shape, size and structure intermediate between *D. mitra* and *D. entzi*; most closely allied to the former species.

Very rare in the material of the "Thor": sts. 126 (275 m. wire), 199 (200 m.—80 m.), singly. Brandt's specimens were taken at the border between the Florida and the Labrador Currents. According to Laackmann (1911) at 0° 27′ N 17° 47′ W, in the South Equatorial Current (German South-Pole Exp., $^{21}/_9$ 1903).

Like *Dictyocysta lepida*, the present species, *D. mitra*, belongs to the most frequent Tintinnids of the Mediterranean, showing a great accordance with that species as to distribution. In winter it was frequent in the Bay of Cadiz, as well as near the south coast of Spain, but was lacking in the Atlantic Current along the north coast of Africa. Like *D. lepida* it was common and abundant in the Tyrrhenian Sea, as well as in the northern Jonian Sea and in the southern Adriatic. During the summer cruise it was altogether absent west of a line from the Baleares to Tunis, and was everywhere very rare and scarce at the surface, but present below the same in nearly all — 19 out of 22 — stations for deep water samples, apparently occurring chiefly at a depth of 100 m. or somewhat more. It extended as far as the entrance to the Dardanelles.

It is a frequent warm-water species, widely distributed in warm-temperate regions of the Atlantic, in the northern temperate zone, as well as in the southern, whilst in truly tropical regions it seems to be rare or partly lacking. To the north it is distributed, at any rate from 30° N (Brandt l. c.) in the western and median regions, and from the Cape Verd Islands in the east (Cleve 1901 d) as far as 53° N

(37° E, Cleve l. c.) and to the Channel (Novbr. 1907, Bulletin trimestriel); in the south it is known from 41° S (6° W) to 14° S (6° W, Cleve l. c.). Also known from the southern Indian Ocean, from the south point of Africa to far south-east of Australia (43° S 117½° E, S/S Akershus, capt. Martin, March 1911; see also Cleve 1901 a) and in the north to 25° S (56° E, German South-Pole Exp., 15/5 1903, Laackmann 1911).

In the Mediterranean it was detected by Haeckel (l. c.) at Messina. Afterwards it was recorded from Naples by Entz sen. and by Daday 1887, from Syracuse by Lohmann (1908), and from the coast of Dalmatia by Laackmann (1913).

PETALOTRICHA Kent.

Lorica short and wide, campanulate or roundish; wall double, with distinctly separated and well developed outer and inner lamellæ. Lorica in the upper portion more or less constricted and provided with a strong, inwards protruding, circular rib, dividing the lorica into a lower "lorica proper" and an upper "collar", which again is divided by a similar rib into an upwardly dilated lower "neck" and a more or less spreading and narrow, oral rim. Structure a more or less inconspicuous "primary one", also present between the lamellæ (in 2—3 layers, Entz jun. 1909 p. 109); in addition there are more or less scattered or numerous, oval to roundish windows of small size, confined to a smaller portion of lorica, mostly in a more or less broad circular zone near the maximum of diameter, according to Entz l. c. being perforations, according to Brandt 1907 "vesicular bodies". Also a "secondary" structure of the usual appearence may be present, as well as rounded markings or small windows along the upper annular rib, with or without conspicuous radiating striæ of the neck or of the oral rim.

Animalcule with 18 membranelles (Daday 1887, Entz jun. 1909), low, rounded lobes of peristome collar, and only one large macronucleus (Daday l. c., Entz jun. l. c. in part, Laackmann 1911); also many small nuclei are reported (Daday l. c., Entz l. c. — up to 300; sporulation?).

PETALOTRICHA AMPULLA (Fol) Kent (Fig. 99 p. 89).

Kent 1881, p. 627, figs. 1, 2. Tintinnus ampulla Fól 1881 p. 20, pl. 1, figs. 1—3; 1884 p. 53, pl. 4 figs. 1—3, pl. 5 fig. 7. Petalotricha ampulla Daday 1887, p. 572, pl. 21, figs. 7, 11, 12, 14, 17—19.

Sts. Port Alice, 14, 18, 23, 25, 27, 28, 29, 31, 36, 38, 58, 59 (several), 60 (abundant), 62 (several), 64, 66 (abundant and by far predominant), 68 (common and predominant), 69 (several); 81 (100 m. wire), 87 (numerous), 89, 99, 126 (200 m.—100 m., 275 m. wire), 129 (80 m.—0 m.), 134 (125 m.—75 m., 200 m.—125 m., 350 m.—185 m.), 139, 163 (80 m.—0 m.), 186 (245 m. wire), 199 (200 m.—80 m.), 205, 209 (80 m.—33 m., 200 m.—85 m., 1945 m. wire), 234 (100 m.—25 m., common; 200 m.—95 m., abundant and predominant). Singly or very scarce, where not otherwise mentioned.

Lorica below rounded, or provided with a tiny, obtuse point, or mamilla. Near the inner edge of oral rim a rather regular series of conspicuous small windows; the outer border frequently rather regularly denticulate. Otherwise, see the generic diagnosis.

Is a rather common warm-water species, of wide distribution. Its occurrence in the Mediterranean was rather singular. During the winter cruise it was only taken in the median and northern regions of the Mediterranean and at two stations of the Eastern Mediterranean, otherwise only just inside the Straits of Gibraltar, being here, as well as in Bay of Cadiz present everywhere, plentiful or even abundant. It was lacking in the Atlantic Current along the African coast.

During the summer cruise it was present sparsely in the Bay of Cadiz, but absent in the western regions of the Mediterranean, save at a single station (99) just inside the Straits. Now, in summer, it was

on the whole almost only present at deeper levels, and also there only rare or in single individuals; at the surface, it was only taken singly at two stations (205 and 139) in the Balearic.

Accordingly, there seem to be good conditions for an immigration into the Mediterranean from the Atlantic in winter, these, however, giving a negative result, at any rate as to the surface. On the other hand, the scarce occurrence in deeper layers in summer, together with the relative frequency at the surface in winter, seems to indicate that the Mediterranean stock is essentially dependant on immigration into that sea from the west, probably in late autumn.

On the whole, this species is rather common and often occurring in greater numbers in the warmer and warm-temperate regions of the Atlantic, all the way from the south point of Africa and off Buenos Ayres (the Fram 1911) as far as 51°—52° N in the median and eastern regions and to the border between the Florida and the Labrador Currents in the north-west. In the Atlantic it seems to be much more frequent in the temperate regions than in the very warm ones, being particularly plentiful in cooler

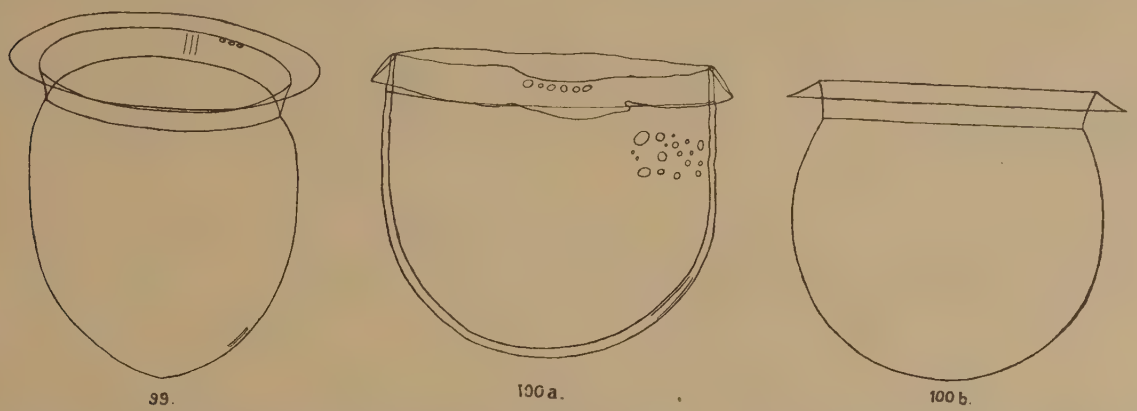


Fig. 99. Petalotricha ampulla (Fol) Kent; $^{350}/_{1}$. Outline of a specimen from st. 234. Fig. 100. Petalotricha ampulla (Fol) Kent var. major n. var.; $^{350}/_{1}$. a: a deformed specimen from a slide. b: the same according to a sketch and the noted dimensions.

currents of the tropical zone. Also known from the Indian Ocean (Mascarene Current, far west and south-west of Australia, Red Sea and Arabian Gulf) and from the Pacific (New Zealand and New Pomerania). (According to Cleve 1901 d, Brandt 1907, Laackmann 1911 and my own samples).

A very striking form is

var. **major** n. var. (Fig. 100).

Petalotricha ampulla var. b Brandt 1906/7 p. 341, pl. 62 figs. 8, 15 (?).

Lorica almost spherical, with an upwardly somewhat dilated "neck" and a spreading, somewhat recurved, oral rim. Length of lorica proper 114 μ, diameter at base of collar 102 μ, at outer border of oral rim 128 μ.

Only one individual seen, at st. 170 (80 m.—20 m., in the Marmora Sea). It was not immediately figured — only provisionally sketched — and was deformed in the slide. I have therefore given two figures of it, one (fig. 100 a) answering to the deformed individual; the other (fig. 100 b) altered according to my (earlier) sketch.

From st. 87, at the south-western corner of Portugal (Cape San Vincent), I saw among many normal individuals a deviating one, perhaps answering partly to *P. entzi* Kofoid 1915. Unfortunately, this specimen was lost, and I did not succeed in finding another.

Petalotricha ampulla was detected in the Mediterranean at Villefranche by Fol (1881). Afterwards it was reported from Naples by Entz sen. (1884) and by Daday (1887), from the northern Adriatic by Entz jun. (1904), and from Syracuse by Lohmann 1908.

CODONELLA Hck.

Lorica urn-shaped, above divided by a constriction into a lower, roundish or oval, lorica proper, and an upper collar, conical or ascending, sometimes incurved towards the upper border. No helicoidal "annuli". Wall of lorica double, with two, more or less distinctly separated lamellæ, above apparently single. Structure an irregular reticulation of unequal-sized, partly very coarse "secondary" meshes, answering to an irregular "*Cyttarocylis*-structure", in addition to a finer "primary one"; structure of lorica sometimes more or less completely concealed by a close "incrustation" of agglutinated "foreign" bodies, answering to those in the genus *Tinntinnopsis*. The species may, however, easily be distinguished from those of the latter genus by having a "collar".

Animalcule recorded to have many nuclei as in the genus *Cyttarocylis*, which on the whole seems to be the most nearly allied genus.

An apparatus for shutting off the lorica at about the level of the constriction below the collar, is present, at any rate in some species. Outsides, the lorica may be covered by more or less regularly arranged, rounded or oval discs, with or without a pore or grain or rod in the middle, most probably coccoliths, disappearing in diluted acids.

1. CODONELLA GALEA Hck. (Fig. 101 p. 91).

Haeckel 1873 p. 567, pl. 28 figs. 8, 9; Fol 1884 p. 61, pl. V fig. 14. Codonella lagenula Entz 1884, 1885, Daday 1887, Cleve 1901 d, 1902 b, 1903 b, not Tintinnus lagenula Claparède & Lachmann 1858 p. 204, pl. 8 figs. 10, 11.

Sts. 10 (abundant and by far predominant), 11, Port Alice, 12 (abundant), 14 (numerous), 15 (numerous), Naupaktos, 18, 20 (several), Taormina, 23 (abundant), 24 (numerous), 25 (rather numerous), 26, 27 (several), 28 (abundant), 29, 31 (several), 33 (several), 35, 36, 38 (several), 39 (several), 40, 42, 50, 53 (common and by far predominant), 55 (several), 57, 58, 59 (several), 60, 62, 66 (numerous), 68 (several), 69; 81 (0 m., numerous and alone; 100 m. wire, common and predominant), 87, 89, 92 (numerous), 93, 94, 95 (several), 96, 98 (several), 99 (several), 100, 115, 116, 118, 120, 123, 126 (500 m.—120 m., 275 m. wire), 128 (100 m.—0 m.), 129 (600 m.—0 m., 1100 m.—0 m.), 132 (600 m.—195 m. singly); 1090 m.—57 m., common), 134 (75 m.—0 m., 125 m.—75 m., 200 m.—125 m., 350 m.—185 m.), 152 (250 m. wire; 950 m wire, several), 156 (0 m., 250 m. wire, 950 m. wire), 160 (100 m.—30 m.; 200 m.—100 m., many; 1000 m.—200 m., many), 163 (80 m.—0 m., several), 182 (545 m. wire), 183, 184 (945 m. wire), 185, 186 (0 m., singly; 245 m. wire, many; 1145 m. wire, several; in Salpæ), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), 190, 192 (0 m., 545 m. wire), 194 (0 m., singly; 1145 m. wire, several), 199 (200 m.—80 m., 945 m. wire), 204 (0 m., singly, 945 m. wire, several), 205, 206 (1945 m. wire), 209 (80 m.—33 m., 200 m.—85 m.; 1000 m.—200 m., common; 945 m. wire, common; 1945 m. wire, several), 210, 211, 213, 217, 228 (1145 m. wire), Gibraltar, 231 (1145 m. wire), 234 (0 m., singly; 25 m.—0 m., several; 100 m.—25 m., numerous; 200 m.—95 m., numerous; 700 m.—200 m., common and predominant), 235. Scarce when not otherwise mentioned.

Lorica proper oval or obovate, slightly widened above the middle, below very obtuse or usually rounded, rarely slightly acutish. Collar conically dilated towards the mouth. Structure highly varying, owing to more or less numerous, agglutinated, bodies of different kinds, rather frequently as in *Tintinnopsis* of irregular, angular and shining bodies. intermingled with opaque, black particles, sometimes of coccoliths, particularly circular, quite regularly disposed discs with a dot (pore) in the middle, apparently belonging to *Coccolithophora leptopora* Lohm. (but generally not overlapping). These coccoliths may be removed by diluted acids; a structure of very coarse "secondary" meshes then appears, with a finer one in the interstices, partly also larger "windows".

Length 86 μ—104 μ, of which the collar makes 23 μ—26 μ; diameter of mouth 46 μ—59 μ, at the

constriction (base of collar) 38 μ—45 μ, maximum diameter (at about the upper $^1/_3$ of lorica proper) 57 μ—63 μ. The more frequent coccoliths or corresponding markings 5 μ—6 μ.

Wall of lorica single and thin in the upper half of collar and in the lower portion of lorica proper, apparently nowhere with well developed and separated lamellæ.

Is a very constant and easily distinguished species, save only for the rather different "incrustation".

During the winter cruise it was present in the surface almost everywhere, save in the Atlantic Current along the coast of Africa. Was present at several stations in greater numbers, as in Bay of Cadiz, at st. 53 in the eastern Alboran Sea, off Naples and in the Jonian Sea, near the coast of Italy.

In summer it was only taken at $^1/_3$ of all stations, again lacking in the Atlantic Current, save just inside the Straits in June. In the western regions of the Mediterranean, west of Sardinia, it was not rare in the surface, particularly in the moderately salt water of the middle and the northern Balearic, as well as in the Catalonian and the Ligurian Seas; farther to the east it was almost wholly confined to deeper layers, being only met with in the surface at seven stations singly, whilst present almost everywhere at some deeper level, taken at 20 of the 22 stations for deep water samples. At the latter stations

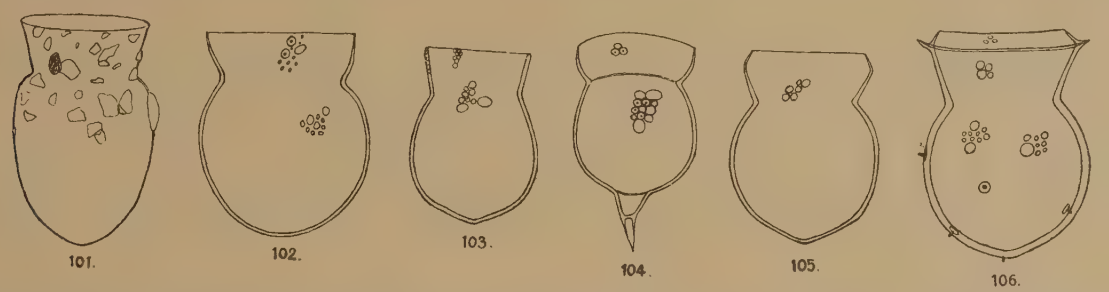


Fig. 101. *Codonella galea* Hck.; $^{350}/_1$. Naupaktos. Fig. 102. *Codonella nationalis* Bdt.; $^{350}/_1$. Taormina. Fig. 103. *Codonella acerca* n. sp.; $^{350}/_1$. St. 156, 250 m. wire. Fig. 104. *Codonella amphorella* Biederm.; $^{350}/_1$. St. 152. 250 m. wire. Fig. 105. *Codonella perforata* Entz; $^{350}/_1$. St. 11. Fig. 106. *Codonella cistellula* (Fol) Bdt.; $^{350}/_1$. Taormina.

it seems to be most frequent at a greater depth, between 100 m. and 200 m., and somewhat deeper. Also at st. 234 near the west coast of Portugal it was relatively most plentiful beneath 200 m.

Haeckel detected the species at Messina (and Lanzarote, Canaries); it is, however, perhaps not quite certain that his species really is that which is now generally named *Codonella galea*. He states the width as 80 μ (with a length of 100 μ which is not very excessive), and he figures the lorica proper almost spherical, by a collar of just the correct and very characteristic shape. The species of Fol (1884) is, however, quite certainly the present one; he found it abundant at Villefranche. In the same year it was reported from Genoa by Gruber, and afterwards from Naples by Entz sen. (1884) and Daday (1887), from the northern Adriatic by Entz jun. (1904), and from Syracuse by Lohmann (1908).

Is widely distributed in the Atlantic, from the south point of Africa and 31° S (the Fram 1911) at any rate to $43^1/_2$° N (the Texas, capt. Pedersen, April 1910), frequent on the European, as well as on the American side. Also known from the Red Sea, the Arabian Gulf and the Mascarene Current in the Indian Ocean.

2. CODONELLA NATIONALIS Bdt. (Fig. 102).

Brandt 1906 p. 3, pl. 5 figs. 9, 10, pl. 6 figs. 1, 2, pl. 10 fig. 10; 1907 p. 91. Dictyocysta polymorpha Entz sen. 1885 p. p. Cyttarocylis polymorpha Daday 1887. 577, pl. 20 figs. 25, 26, 30 (29?).

Sts. 10, 11, 14, 16, Naupaktos, 18, 20, Taormina (numerous), 23 (numerous), 24, 25, 26, 27, 28 (numerous), 29 (several), 31, 33, 38, 40, 42, 45, 55, 66, 68; 92, 126 (500 m.—120 m.), 129 (1100 m.—0 m.), 134 (125 m.—75 m.), 152 (250 m. wire), 156 (950 m. wire), 163 (80 m.—0 m.), 182 (545 m. wire), 186 (0 m., 245 m. wire, 1145 m. wire, and in Salpæ), 189 (945 m. wire), 199 (200 m.—80 m., 945 m. wire), 200, 204

(945 m. wire), 206 (1945 m. wire), 208, 209 (1000 m.—200 m., 945 m. wire), 211, 220, 224, 234 (100 m.—25 m., 700 m.—200 m.).

Lorica somewhat similar to that of the preceding species, but more clumsy. Lorica proper broadly oval or almost spherical, below usually evenly rounded. Collar ascending by convex lateral outlines, above erect. Wall of lorica rather thick, with well developed, but approximated outer and inner lamellæ, save towards the mouth. Structure of "secondary" polygonal, unequal-sized meshes in a single layer between the two lamellæ, together with a relatively coarse "primary" structure; in addition, frequently greater, roundish or mostly oval "windows", irregularly scattered, are present. Collar sometimes low, perhaps in young loricæ.

Length 85 μ—107 μ, of which the fully developed collar makes 25 μ—28 μ; diameter of mouth 62 μ—70 μ, of constriction above 49 μ—57 μ, maximum diameter 65 μ—77 μ.

Most meshes about 3 μ in diameter, the larger ones usually 7 μ—8 μ.

Perhaps DADAY is right in considering this species to belong rather to *Cyttarocylis*; in structure it seems to be allied to *C. eucecryphalus*; is, however, also certainly allied to the preceding species and the next following ones.

This species, still only known from rather few localities, proved to be frequent in the Mediterranean during the winter cruise, being present all along the route, only wanting at very few stations. In summer it had mostly disappeared from the surface, being only met with at five stations of the Western and one of the Eastern Mediterranean. It was taken at more than half the stations for deep water samples, throughout the Mediterranean as far as Euboea, though nowhere in greater numbers. In January there is perhaps an immigration into the Mediterranean from the Atlantic, probably also in late autumn and perhaps in June, in the latter season only if we may suppose the species to pass over into deeper layers in the Western Mediterranean.

Seems to be indigeneous in the Mediterranean, occurring at the surface as a winter species; the stock is probably maintained through some immigration into the Mediteranean from the Atlantic every year.

This species was already detected in the Mediterranean by ENTZ sen. (l. c.) at Naples, was known from the same place by DADAY, was taken by LOHMANN at Messina (BRANDT l. c.) and afterwards reported by ENTZ jun. (1904) from the northern Adriatic. Otherwise it has been taken from 21° S (5° W, 400 m., German South-Pole Exp. $^{25}/_{8}$ 1903) and 23° S 37° W — very frequent between South Africa and Brazil (the Fram, Aug. 1911) — to near the border between the Florida Current and the Labrador Current, far south-east of Nova Scotia, and to the Azores, only stated at few, distant localities (BRANDT l. c.). Also in the Pacific (New Pomerania and Tonga Islands, BRANDT l. c.).

3. CODONELLA ACERCA n. sp. ad int. (Fig. 103 p. 91).

C. nationalis Brandt var. b? 1907 p. 93, pl. 5 figs. 11, 11 a.

Sts. 152 (950 m. wire), 156 (250 m. wire, 950 m. wire), 160 (30 m.—0 m.), 163 (80 m.—0 m.), 187 (945 m. wire); everywhere singly.

Lorica very similar to that of the following species, but without caudal prolongation. Collar slightly dilated in an upward direction, or towards the mouth erect to slightly incurved. Lorica proper broadly ovate or oval, with maximum of diameter below the middle, at the lower end broadly obtuse-angled (on the optical section). Wall of lorica thin and single, or not distinctly double, the outer and the inner lamellæ being incompletely developed and separated, though showing a "secondary" structure of a single layer of "prismatic elements" (seen on the optical section). On the outside of the lorica the "secondary" meshes ary very unequal-sized, roundish polygonal, mostly 2 μ—3 μ, partly much larger and frequently oval, towards the mouth mostly very small.

Length 64 μ—72 μ, of lorica proper 47 μ—49 μ; diameter of mouth 40 μ—43 μ, at the constriction 36 μ—37 μ, maximum diameter 48 μ—52 μ.

Differs from *C. nationalis* in being smaller, of a less clumsy appearance, in having a thinner wall of lorica, a maximum diameter in the lower portion — in *C. nationalis* mostly somewhat above the middle — and the obtuse-angled outline below. Is so strikingly similar to *C. amphorella* that I should have considered it a "tailless" variety of that species if I had seen any forms suggestive of a transition.

I was only lately aware that this form differed from *C. nationalis*, and too late to be able to ascertain that is was not taken also in winter, which some of my notes seem to suggest. In summer it only seemed to occur sparsely and rarely below the surface in the Eastern Mediterranean.

4. CODONELLA AMPHORELLA Biederm. (Fig. 104 p. 91).

Biedermann 1892 p. 16, pl. II fig. 1; Brandt 1907 p. 100 pl. 9, figs. 2, 3, pl. 10 fig. 8; Laackmann 1911 p. 439, pl. XLIX fig. 4.

Sts. 10, 11; 152 (250 m. wire, 950 m. wire), 156 (950 m. wire), 160 (200 m.—100 m., 1000 m.—200 m.), 182 (545 m. wire), 186 (1145 m. wire), 187 (945 m. wire), 189 (945 m. wire), everywhere singly or very sparsely.

Lorica similar to that of the preceding species, only provided with a caudal prolongation of medium length, very acute and with an inner transverse wall at about the upper $^2/_5$ of length.

Total length of the figured specimen 88 μ, of caudal prolongation 20 μ, of lorica proper 45 μ; diameter of mouth 45 μ, diameter at the constriction 38 μ, maximum diameter (below) 50 μ.

Very rare and scarce in the material of the "Thor", only taken in the Eastern Mediterranean. Otherwise met with west of southern South-Africa (German South-Pole Exp. $^{8-19}/_8$ 1903, see Laackmann l. c.) and from about 9° S in the Atlantic as far as to the northern regions of the Florida Current (Brandt l. c.) and to about $41^1/_2$° N 43° W (S/S Texas, April 1910, capt. Pedersen). Deviating forms (according to Brandt l. c.) in the Agulhas Current and from New Pomerania.

It was first recorded from the Mediterranean by Entz jun. 1909, from Naples.

5. CODONELLA PERFORATA Entz sen. (Fig. 105 p. 91).

Entz sen. 1884 p. 415, pl. 24 figs. 12—14. C. polymorpha Entz sen. 1885 p. 205 p. p., pl. 14 figs. 1, 2. C. perforata Brandt 1907 p. 95, pl. 6 figs. 3, 4, 8, pl. 10 fig. 11, incl. var. a p. 96, pl. 6 figs. 6, 7.

Sts. 10 (many), 11 (several), 14, 16, Naupaktos, 23, 24 (several), 25, 26, 28, 66, 68; 92, 95, 148, 152 (250 m. wire, 950 m. wire), 160 (100 m.—30 m.), 163 (80 m.—0 m.), 164. Singly or sparsely, when not otherwise noted.

Lorica in shape and size very similar to that of *C. acerca*, but the collar consists of a lower portion, conically dilated in an upward direction, and an upper, conically narrowing to almost the same extent, both of them united at their maximum diameter, at or above the middle of collar. Lorica proper broadly oval, maximum diameter about the middle, below frequently with a more or less distinct, obtuse, point. Wall rather thin, without distinctly developed lamellæ, mostly with a single layer of "prismatic elements", on the outside appearing as strongly outlined "secondary", polygonal and unequal-sized meshes. Around the lorica at its greatest width there is frequently a double or multiple row of particularly large, rounded or oblong, "windows", sometimes scattered about in different places.

Total length of well developed specimens 79 μ—85 μ, of lorica proper 57 μ—62 μ; diameter of mouth 45 μ—47 μ, of constriction at base of collar 42 μ—44 μ, maximum diameter of lorica proper about 60 μ, of collar 54 μ—57 μ.

May easily be confounded with *C. acerca*, and presumably also with younger forms (?) of the following species, on account of which the Mediterranean distribution may need revision.

The distribution and extent of this species are altogether too little known as yet. It is recorded from one locality in the Sargasso Sea, one near the Azores, from the Bay of Bengal and New Pomerania

(Brandt l. c.), as well as three localities in the North- and in the South Equatorial Current (German South-Pole Exp. $^{26}/_{8}$, $^{7}/_{9}$, $^{1}/_{10}$ 1903, Lackmann 1911). In the Atlantic it has been taken from 21° S, far west of South-Africa (German South-Pole Exp. $^{25}/_{8}$ 1903), to near the Azores (Brandt l. c.) and to 31° N in the Florida Current off the coast of North America (the Texas, Novbr. 1909, capt. Pedersen). It is also met with in the Indian Ocean (Bay of Bengal, Brandt l. c., and at $39^{1}/_{2}$° S, south-west of the south-western corner of Australia, the Tasmanic, May 1910, capt. Håkonsson) as well as in the Pacific (New Pomerania, Brandt l. c.).

6. CODONELLA CISTELLULA (Fol) Bdt. (Fig. 106 p. 91).

Brandt 1907 p. 96, pl. 8 fig. 4, incl. varr. a—c pp. 98, 99, pl. 7 fig. 3, pl. 8 figs. 1—3. Cyttarocylis cistellula Fol 1884 p. 56, pl. V fig. 8; Daday 1887 p. 578, pl. 20 fig. 27, pl. 21 figs. 2, 10, 15, 20. Cyttarocylis punctata Daday 1886 p. 495, pl. 25 fig. 13.

Sts. 10, 11, Port Alice, 12, 14, 16, 18, 20, Taormina, off Naples, 23, 24, 25, 26, 27, 28 (several), 29, 31, 35, 36, 38, 39, 42, Galita, 45, 50, 55, 59; 126 (200 m.—100 m.), 128 (100 m.—0 m.), 129 (80 m.—0 m., 600 m.—0 m., 1100 m.—0 m.), 132 (1090 m.—57 m.), 134 (125 m.—75 m., several; 200 m.—125 m.), 152 (250 m. wire, 950 m. wire), 156 (250 m. wire, 950 m. wire), 160 (100 m.—30 m., 200 m.—100 m.), 163 (80 m.—0 m.), 182 (545 m. wire), 183, 186 (0 m., 245 m. wire, 1145 m. wire), 187 (190 m.—100 m., 945 m. wire), 189 (945 m. wire), 192 (545 m. wire), 194 (0 m., 1145 m. wire), 199 (200 m.—80 m.; 945 m. wire, several), 202, 204 (945 m. wire), 206 (1945 m. wire), 209 (80 m.—33 m., 1000 m.—200 m., 945 m. wire, 1945 m. wire), 210, 231 (1145 m. wire), 234 (200 m.—95 m.). Scarce or singly if not otherwise mentioned.

Resembles a large and strong form of the preceding species, but having a prominent supporting rib around the collar at its greatest diameter. Lorica proper mostly spherically rounded, more rarely showing a small, obtuse point below. Collar with a larger lower, upwards conically dilated, portion, and a short upper one, conically narrowing; where they unite, at their maximum of diameter, a more or less strongly developed, obliquely spreading, annular rib is situated, making this species very easily distinguished.

Total length of figured specimen 96 μ, of lorica proper 64 μ; diameter of mouth 52 μ, of constriction 48 μ, maximum diameter of lorica 66 μ, of annular rib 70 μ.

Structure consisting of larger and smaller "secondary" meshes, different in shape, partly with agglutinated discs, mostly circular and frequently with a shining grain in the middle. Wall of lorica rather thick, at the mouth single and thin, otherwise double, with approximated lamellæ.

Was very frequent in the Mediterranean, nearly everywhere, however, very scarce. In winter it was only wanting (at the surface) at few stations, whilst in summer it was very rare at the surface, but present at some deeper level nearly everywhere at the stations where such samples were taken. In summer as well as in winter, it was most frequent in the Tyrrhenian Sea.

Is certainly a true, indigeneous Mediterranean species, only a very faint indication of an invasion from the west in winter being suggested in the material in question. Generally distributed at the surface in winter it disappears towards summer, to reappear in certain deeper layers, a phenomenon, remarkably frequent among the Tintinnids of the Mediterranean.

Otherwise, the distribution in the Atlantic is remarkably similar to that of *C. nationalis*. It is also known from New Pomerania in the Pacific (Brandt l. c.).

In the Mediterranean it was detected as a new species at Villefranche by Fol (l. c.) and was afterwards taken at Naples by Daday (l. c.), in the northern Adriatic by Entz jun. (1904), at Messina by Lohmann (Brandt l. c.), also at Syracuse (Lohmann 1908).

STENOSEMELLA n. gen. ad int.

Lorica short and wide, of a firm consistence, strongly covered with agglutinated bodies of the same kind as in *Tintinnopsis*, completely concealing the real structure of the wall. No caudal prolongation, nor any distinct helicoidal constitution of the wall. Round the mouth is developed a low (narrow) collar, thin-walled and mostly destitute of agglutinated bodies or, at any rate, less closely covered than the rest of the lorica, in rare cases perhaps consisting of two or three narrow turns of a helicoidal band.

Animalcule with two macro- and two micronuclei (according to ENTZ jun., LAACKMANN and others); membranelles 20 (ENTZ 1909). According to FAURÉ-FREMIET (1924 pp. 95—98, fig. 31) it is fixed to the bottom of the lorica, without a pedicle, in a swimming state extended far beyond the mouth of the lorica, above dilated to a very broad peristome collar, without distinct lobules. The outermost (largest) cilia of the membranelles incrassated in lower $^1/_3$ to a sort of joint, which apparently enables the upper portion to move freely in an outwards direction.

1. STENOSEMELLA VENTRICOSA (Clap. et Lachm.) (Fig. 107).

Tintinnus ventricosus Claparède et Lachmann 1858 p. 208, pl. IX fig. 4. Codonella ventricosa Fol 1884 p. 59, pl. 5 fig. 12. Tintinnopsis ventricosa Cleve (pp.) 1900 a; Brandt 1906/7 (pp.), pl. 17 fig. 9. T. ventricosa var. major Fauré-Fremiet 1908 p. 32 fig. 18. T. ventricosoides Meunier 1910 p. 143, pl. XIII figs. 1—8.

Sts. 16, 45, 46 (in greater numbers), 58 (abundant), 59 (in rather great numbers), 62 (likewise), 66, 68; Cadiz, 101, 170 (1000 m.—195 m.), 223 (1950 m. wire), 228 (1145 m. wire), Lisbon, 237, Brest (in greater numbers).

Lorica more or less completely covered with agglutinated, mostly shining and sharp-edged pieces, oval, below somewhat pointed, but at the very end rounded or very obtuse, above rather abruptly narrowed by rounded outlines. Wall very firm and presumably double; the real constitution cannot, however, be seen with any certainty in the optical section, on account of the numerous agglutinated bodies, in connection with the wide, rounded shape of the lorica. Collar of a less firm consistence than the rest of the lorica, low and sometimes scarcely prominent, usually single-walled and simple, sometimes perhaps with two or three indistinct "annuli" (?).

Length 70 μ—77 μ, diameter of collar (mouth) 31 μ—32 μ; length (height) of collar 2 μ—3 μ, rarely more, maximum diameter of lorica 65 μ—74 μ.

This species has been partly confounded with two others, with *Stenosemella steini* (Jørg. 1912) — see BRANDT 1906/7 pl. 17 fig. 2, pl. 18 figs. 1, 2, according to OSTENFELD synonymous to *Codonella relicta* Minkiewicz 1903, a species, widely distributed in the Baltic and the Cattegat (*S. steini*), also occurring in the Sea of Azov and in Lake Aral (*Codonella relicta*) — and with the following smaller species. Its real distribution is therefore at present only imperfectly known. It has been taken on the west coast of Norway (Clap. et LACHM., JØRGENSEN 1899), in Skagerrack (AURIVILIUS 1898, JØRGENSEN 1912), in the Channel (CLEVE 1900 a, FAURÉ-FREMIET 1908), in the North Sea (CLEVE 1900 a, MEUNIER 1919: common in the south-west), near Iceland and the Orkneys (OSTENFELD 1899, 1900), in the innermost regions of the Vestfjord (the Lofoten 0—600 m., rr JØRGENSEN 1905), as well as near the southern island of Novaya Zemlya (rather common, MEUNIER 1910, *Tintinnopsis ventricosoides*.

In the Mediterranean it was first taken by FOL (1884) at Villefranche. Afterwards it was reported from Messina by BRANDT (l. c., taken by LOHMANN 1896), and from Naples and the northern Adriatic by

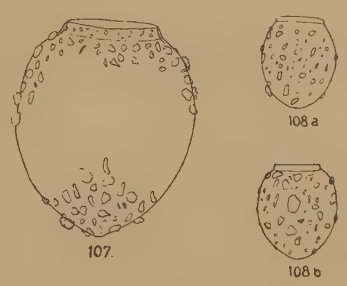


Fig. 107
Stenosemella ventricosa (Clap. et Lachm.); $^{350}/_1$. St. 58; a specimen with incrusted collar.

Fig. 108
Stenosemella nucula (Fol p. p.?, Laackm.); $^{350}/_1$. a: st. 33. b: st. 26.

Enrz jun. (1904 and 1909). In the material of the "Thor" it was only present at few stations, very irregularly scattered, and mostly situated near to the coasts. Like the species of *Tintinnopsis,* this and the following species are chiefly neritic, apparently, however, not so closely confined to the coasts as nearly all species of *Tintinnopsis.*

Stenosemella ventricosa, together with or replaced by nearly allied species, apparently also occurs in many places on warmer coasts, of the Atlantic, as well as of the Pacific and the Indian Ocean.

2. STENOSEMELLA NUCULA (Fol p. p.?, Laackm.) (Fig. 108 p. 95).

Codonella nucula Fol. 1884 p. p.?. Tintinnopsis nucula Laackmann 1906 b p. 19, pl. I fig. 4 (5?) pl. III figs. 48—50. Codonella ventricosa Entz 1884, Imhof 1886, 1891, Möbius 1887, Wright 1907. Tintinnopsis ventricosa Daday 1887, Bresslau 1906. T. nitida var. ovalis Jørgensen 1905 p. 143, pl. XVIII fig. 115. T. nucula Brandt 1907 p. 158 p. p. "T. Bornandi(?)" Entz jun. 1909 p. 199, pl. 8 fig. 5, pl. 9 fig 6, not "T. nucula(?)" pl. 13 figs. 4, 9. T. ventricosa var. minor Fauré-Fremiet 1908 p. 232 fig. 18. T. nivalis Meunier 1910 p. 143, pl. XIII figs. 26, 27, T. oliva Meunier l. c. p. 144, pl. XIII figs. 9—13, T. avellana Meunier 1919 p. 30, pl. XXII fig. 37, T. glans Meunier ibid. figs. 35, 36.

Sts. 11, 14, 24, 26, 28, 29, 31, 33, 38, 55, 58 (abundant), 59, 60, 62, 68; 165, 170 (20 m.—0 m., 80 m.—20 m.), 172 (200 m.—81 m.).

Is remarkably similar to the preceding species, only much smaller. Intermediate forms unknown.

Length usually 37 μ—51 μ, diameter of collar 20 μ—23 μ, maximum diameter 32 μ—45 μ; length (height) of collar 3 μ—6 μ.

Considerably varying in shape — maximum diameter above, at, or rarely below, the middle — as well as in height and diameter of collar. Not seldom the latter seems wanting in empty loricæ, of this as well as of the preceding species; it is, presumably, less lasting than the lorica proper, according to Laackmann (l. c.) it is never wanting in living specimens.

The figure 4 in Laackmann, which might be considered to represent the main species, shows a maximum diameter above the middle of the lorica, a low collar and a wide lorica; Meunier's species *nivalis* and *glans* answer to this figure. *Tintinnopsis oliva* Meunier and f. *ovalis* Jørg. (l. c.) has the greatest width of lorica about the middle. *T. avellana* Meunier seems (to me) to be an accidental form, with the greatest width at or somewhat below the middle, as well as a more conical shape of the lorica in its lower portion.

The animalcule, as in the preceding species, has two macro- and two micronuclei (Laackmann l. c. pl. III fig. 48).

Most probably local or geographical races or varieties may be distinguished (as small-species) in these and other neritic species of wide distribution.

As seen from the list above, this species was very frequent in winter throughout the Mediterranean, whilst in summer, it was only taken in the innermost, less saline regions, from outside the Dardanelles to the Black Sea, where present in the most saline layer. It should, however, be remembered that the present species is too small to be safely caught by plankton nets; it was also rather scarce in the samples, or mostly but present singly.

This species is obviously widely distributed, both in warmer, in temperate and in cooler and colder seas. It is recorded for many places from the Mediterranean along the coasts of southern, western and northern Europe as far as the Barents and Kara Seas. Answering to its frequent occurrence in the less salt water of the Black Sea Region, it extends from the Skagerrack and Cattegat all the way into the western Baltic (see Jørgensen 1912 p. 3).

In regard to the name of this species I have already (l. c.) given my opinion that the specific name *nucula* Laackm. may be used, even though we really cannot exactly decide which species "*Codonella nucula* "Fol (1884) properly represents. The first important condition, that Laackmann's species does occur in the Mediterranean, is undoubtedly verified; his species also answers very well to Fol's descrip-

tion, but — it is true — badly to the figure given by Fol (1884 p. 60, pl. V fig. 13). Daday's *Tintinnopsis nucula* (Daday 1887 p. 554, pl. 19 figs. 30, 31) from Naples seems to be another species, unknown to me, whilst his *T. ventricosa* answers to the present species. Brandt (1907 p. 159) has obviously considered the present species to be that of Fol, but he figures under this name a different form (Brandt 1906 pl. 16 figs. "12 and 10 (? 1, 3, 9, 13, 14)", or probably two species differing from each other, and quotes as synonymous the species of Laackmann with an added "?".

The remarkable figure in Fol is perhaps only intended to show that the collar may have agglutinated bodies. Brandt gives two main figures (10, 12), similar to that in Fol, but scarcely representing the same species as those in Laackmann (1906 b figs. 4, 48—50); in connection with the occurrence at Kiel, the latter author is quoted, and Brandt also himself admits that his species *nucula* (Brandt) perhaps comprises more than one species. For clearness, one should always write *nucula* Laackm.

METACYLIS n. gen. ad int.

Lorica short and wide, broadly oval, having a wide mouth and a very short and wide collar, formed by a helicoidal band with one to few low turns. Wall simple (single) or with indistinctly developed outer an inner lamellæ, more distinct above. No agglutinated foreign bodies present (exceptionally some very few and small accidental ones). Structure indistinct, apparently consisting of a very fine reticulation of slightly elevated plicæ (wrinkles), probably in addition to or coincident with the usual fine "primary" structure.

Animalcule unknown.

Occupies apparently an intermediate position between *Amphorella* and *Codonellopsis* or *Stenosemella*, perhaps more nearly allied to the latter, provisional genus, being, however, of quite another appearance, owing to the thin, hyaline wall.

METACYLIS MEDITERRANEA (Mereschk.) (Fig. 109 p. 98).

Tintinnus mediterraneus Mereschkowsky 1881 p. 211, pl. 12 fig. 1 ("var. neapolitana"); Laackmann 1913 p. 38, pl. VI figs. 88—90. Amphorella mediterranea Daday 1887 p. 543. Codonella Jörgenseni Cleve 1902 a p. 22; v. Breemen 1905 p. 50; Jörgensen 1912 p. 4. Tintinnus urceolatus Brandt 1906 p. 30, pl. 62 fig. 3, not Ostf. Amphorella joergenseni Fauré-Fremiet 1908 p. 235 fig. 22 ("A. jörgensi"). Tintinnus jörgenseni Ostenfeld 1916 p. 133. Ptychocylis amphorella Meunier 1919 p. 14, pl. XXII figs. 4—7.

Sts. Cadiz, 170 (20 m.—0 m., 80 m.—20 m., 1000 m.—195 m.), 175 (350 m. wire), Barcelona, Brest. Everywhere singly or very sparsely.

Lorica hyaline with a short and wide, very short funnelshaped, "annulated" collar, with 2—5 low (narrow) "annuli", and broadly obovate lorica proper, at the lower end with a short point, varying from rudimentary or indistinct to somewhat elongated, with intermediate forms. Structure very indistinct, apparently consisting of a very fine reticulation on a slightly rough surface; no structure, or a still finer one, on the collar.

Length of lorica proper and collar together, but without the caudal prolongation, about 60 μ, the latter up to 14 μ, but frequently very short or only suggested; diameter of mouth abouth 45 μ, maximum diameter 49 μ—51 μ.

Is obviously a coastal form.

The "tailless" variety is

var. **pontica** Mereschk. (Fig. 109 b p. 98).

Mereschkowsky l. c. fig. 2.

Sts. 152 (250 m. wire), 171, 172 (0 m., 50 m.—17 m., 200 m.—51 m.).

On the whole a relatively wider and at the lower end rounded lorica.

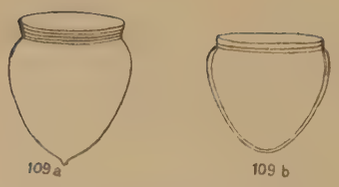


Fig. 109.
Metacylis mediterranea (Mereschk.); $^{350}/_{1}$. a: f. neapolitana Mereschk.; Cadiz (June). b: var. pontica Mereschk.; st. 153.

Length of lorica proper about 50 μ—52 μ, collar about 4 μ—5 μ, maximum diameter 50 μ—54 μ.

Was in the Black Sea relatively most frequent at the deeper level, 200 m.—51 m. The main species was at st. 170 (in the Marmora Sea) proportionately most frequent between 80 m. and 20 m.

Outside the Mediterranean the main form of this species occurs all the way from the Bay of Cadiz to the Channel, the south-western part of the North Sea — where rather common (MEUNIER l. c.) and already stated by CLEVE (l. c.) and v. BREEMEN (l. c.) — Limfjord (Denmark, OSTENFELD l. c.), Skagerrack (JÖRGENSEN l. c.), and Bergen (BRANDT l. c.). In the latter region I have seen it repeatedly in Björnefjord in July. Otherwise I have seen specimens from Bocca Grande near Key West (Florida) and from the East China Sea.

In the Mediterranean it was first observed by MERESCHKOWSKY at Naples, but afterwards not seen till it was recorded by LAACKMANN (l. c.).

CODONELLOPSIS n. gen.

Lorica with an "annulated" collar, distinctly offset from lorica proper, as well as of a different appearance. Lorica proper as in *Codonella*, oval to roundish, with or without a caudal prolongation. Wall with well developed and separated lamellæ. Structure as in *Codonella* consisting of irregular, unequal-sized "secondary" meshes, partly developed as "windows", between which the "primary" structure is generally coarser. More or less frequently agglutinated bodies are found, on the whole similar to those of *Tintinnopsis*, or more or less regularly disposed, rounded or oblong, proportionately thick, discs, with or without a pore or grain (or a small rod) in the centre, most probably coccoliths (see f. i. SCHWEYFR 1909, pl. 10 fig. 3, *C. orthoceras* with agglutinated coccoliths belonging to *Coccolithophora pelagica* (?)). The collar has generally only an inconspicuous primary structure, without "foreign bodies" or with only relatively few and small ones.

The animalcule is reported to have 18 membranelles, rounded (semilunar) lobes of peristome collar, and numerous macronuclei, in the latter respect answering to the genera *Codonella* and *Cyttarocylis* (see pp. 77,90). I have myself found only two macronuclei in the northern *Codonellopsis pusilla* (Cl.) var. *ovata* Jörg. (1899 p. 27, 1905 pl. XVIII fig. 117). A closing apparatus, like that of *Codonella*, is found in *C. orthoceras* (see BRANDT 1906 pl. 8 fig. 6).

1. CODONELLOPSIS ORTHOCERAS (Hck.) Fig. 110 p. 99).

Codonella orthoceras Haeckel 1873 p. 567, pl. 28, fig. 10; Brandt 1907 p. 109, pl. 9 fig. 5, pl. 11 fig. 6, incl. varr. a—f, i, k. Codonella annulata Daday 1887 p. 571, pl. 20 fig. 21, not Tintinnus annulatus Claparède & Lachmann 1858 p. 207, pl. IX fig. 2.

Sts. 10, Port Alice, 14, 16, Naupaktos (common), 20, Taormina, off Naples, 23, 25, 26, 27, 28 (numerous), 29, 31, 35, 38, 39, 40, 42, 45, 55, 68; 126 (275 m. wire), 134 (75 m.—0 m., 125 m.—75 m., 200 m.—125 m., 350 m.—185 m.), 152 (250 m. wire, 950 m. wire), 156 (250 m. wire), 160 (100 m.—30 m., 200 m.—100 m., 1000 m.—200 m.), 186 (245 m. wire, 1145 m. wire), 187 (945 m. wire), 189 (945 m. wire), 199 (945 m. wire), 204 (945 m. wire), 206 (1945 m. wire), 218, 220, 223 (1950 m. wire, many), 224, 228 (0 m., 1145 m. wire), 231 (1145 m. wire). Scarce or in summer mostly singly if not otherwise mentioned.

Lorica in a well developed state with an "annulated" collar of considerable length, sharply offset from lorica proper and with a different structure. Lorica proper oval, frequently more or less irregular in shape, above for a short distance cylindrical, below the base of collar frequently somewhat swollen, obvi-

ously in order to afford a stronger support for the latter. Below an offset, thick and usually very obtuse, caudal prolongation of different length, short to rather elongated, by an inner transverse wall limited from the cavity of the lorica. Collar cylindrical, or more or less widened conically towards the mouth, consisting of very numerous, more or less low (or narrow) turns of a helicoidal band, towards the mouth — which in cylindrical collars is usually more or less abruptly curved outwards — very low; wall showing well developed and separated lamellæ. Structure of lorica proper generally completely concealed by a more or less continuous agglutination of a similar appearance to that in *Tintinnopsis* — sharp-edged, shining, larger and smaller pieces intermingled with opaque or blackish particles or different other "foreign bodies" — more rarely of coccolith-shaped shells of regular shape and disposition, as in the genus *Codonella*. Collar usually completely destitute of agglutinated bodies or at any rate with much more distant and small ones; otherwise nearly always showing only the inconspicuous "primary" structure. Where the lorica proper is destitute of "foreign bodies", this delicate "primary", as well as a coarser "secondary" structure is generally seen, sometimes together with a still coarser "tertiary" one (BRANDT), which, however, at any rate partly, may only be markings left by deciduous foreign bodies. Very frequent are large, roundish "windows", containing a primary structure and separated by areas with a similar, but coarser one.

Total length of well developed specimens 200 μ—300 μ; length of lorica proper 85 μ—110 μ, of caudal prolongation 20 μ—50 μ, of collar 90 μ—130 μ. Maximum diameter of lorica proper 71 μ—78 μ, diameter of mouth 64 μ—68 μ, of collar at base 51 μ—54 μ. The collar may, however, also be quite short, even squarish (in optical section) or shorter, in — probably — young or not quite normally developed specimens.

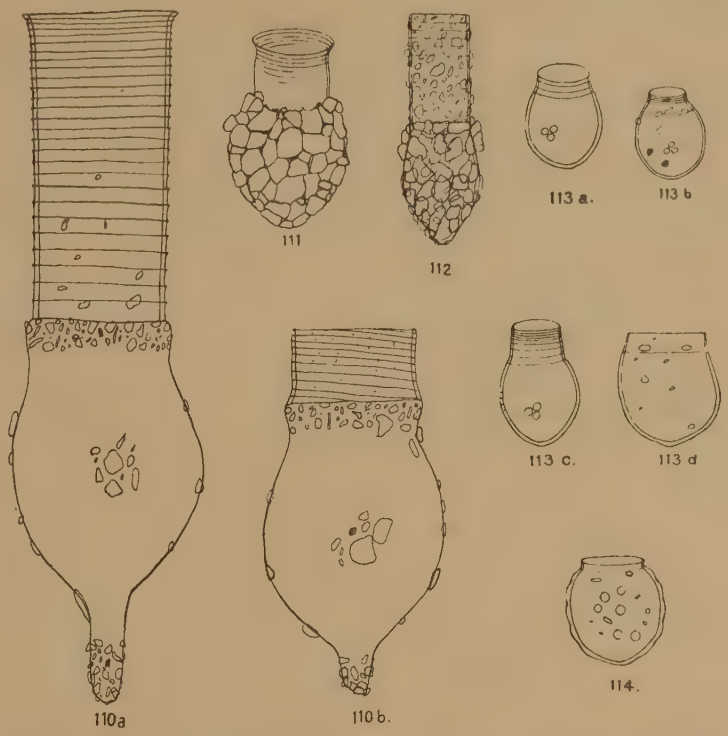


Fig. 110. *Codonellopsis orthoceras* (Hck.); Naupaktos, $^{350}/_{1}$. b: a specimen with a short, presumably unfinished, collar. Fig. 111. *Codonellopsis morchella* (Cl.); $^{350}/_{1}$. Florida Current 30° 27′ N 80° 4′ W, S/S Texas, capt. Pedersen $^{30}/_{11}$ 1909. Fig. 112. *Codonellopsis lusitanica* n. sp.; $^{350}/_{1}$. Lisbon. Fig. 113. *Codonellopsis lagenula* (Clap. et Lachm.); $^{350}/_{1}$. a: west of Bergen, $^{10}/_{10}$ 1901. b: st. 206. c: st. 80, in Salpæ. d: st. 172; perhaps specifically different. Fig. 114. *Codonellopsis(?) tuberculata?* (Dad.); $^{350}/_{1}$. St. 172, 200 m.—50 m.; only a few of the scattered circles shown.

This frequent and easily recognized warm-water species was a common winter species at the surface of the Mediterranean, during the winter cruise present all along the route and off Naples present at most stations in proportionately great numbers, in the Bay of Patras common. During the summer cruise the circumstances had changed; on the inward journey it was not met with until the Tyrrhenian Sea (st. 126) and only below the surface (275 m. wire), being in all only taken at the surface at a few western stations in September, whilst present at most stations throughout the Mediterranean where deep water samples were taken. The samples are directly suggestive of an immigration into the Mediterranean from the west in January and in September; I have also seen the species from Straits of Gibraltar in Decbr. 1908 (S/S Sevilla, capt. RÖD). The distribution in the Mediterranean in winter seems, on the whole, to answer to an immigration into that sea from the west in late autumn.

Outside the Mediterranean this species is widely distributed in the Atlantic, from west of South Africa, in the Benguela Current (Brandt l. c.) to Rio de Janeiro (the Fram 1911) and in the north as far as the border between the Florida and Labrador Currents, exceptionally to 50° N, far south-west of Ireland (Cleve 1901 d). Seems to be frequent in the Indian Ocean (Red Sea, Arabian Gulf, Bay of Bengal, Malay-Archipelago, Mascarene Current, see Cleve 1901 c, 1903 b, Ostenfeld and Schmidt 1901, Brandt 1907, Laackmann 1911) and is also taken near New Pomerania in the Pacific (Brandt l. c.).

Codonellopsis orthoceras was first detected by Haeckel at Messina (see Haeckel l. c.) and afterwards recorded by Daday from Naples (1887), by Cleve (1903 b) from the Alboran Sea and the southern Balearic, by Entz jun. (1904) from the northern Adriatic, and by Lohmann (1908) from Syracuse.

2. CODONELLOPSIS MORCHELLA (Cl.) (Fig. 111 p. 99).

Codonella morchella Cleve 1900 pp. 969—970; Brandt 1906/7 p. 124, pl. 13 figs. 1—3, pl. 14 fig. 3, pl. 15 fig. 1, incl. var. erythräensis p. 126, pl. 14 fig. 4.

Lorica with an oval "lorica proper", closely covered with agglutinated foreign bodies of the *Tintinnopsis*-type, and a strongly offset, hyaline, almost cylindrical, shorter, "annulated" collar without foreign bodies, somewhat dilated at its mouth.

Total length 86 μ, length of lorica proper 68 μ; diameter of mouth 51 μ, maximum diameter 61 μ.

Only a single individual was seen, at st. 66 (Bay of Cadiz).

Is a subtropical species of wide distribution, particularly known from coastal waters, to the north as far as the New Foundland Bank and to near the Azores (in Novbr. Cleve 1901 d). Is widely distributed in the northern warmer regions of the Indian Ocean, and is also known from the Malay Archipelago and from New Pomerania in the Pacific (Ostenfeld and Schmidt, Cleve 1901 c, Brandt l. c.).

3. CODONELLOPSIS LUSITANICA n. sp. (Fig. 112 p. 99).

Lorica similar to that of the preceding species, but different in shape and in other respects. Collar cylindrical, consisting of numerous, less conspicuous "annuli", the border lines of which are partly concealed by numerous agglutinated "foreign bodies" of rather small size. Lorica proper rather similar to that of *Tintinnopsis beroidea* Entz, almost cylindrical, or slowly narrowing, to below the middle, then more rapidly and conically narrowed into an obtuse or rounded lower end, closely covered all over with larger and smaller pieces, throughout much greater and closer than on the collar.

Total length of a well developed specimen 94 μ, of lorica proper 50 μ; diameter of mouth 23 μ, maximum of diameter (below the middle of lorica proper) 34 μ. Only seen very sparsely from Lisbon Roads ($^{13}/_{9}$ 1910).

4. CODONELLOPSIS LAGENULA (Clap. et Lachm.) Fig. 113 p. 99).

Tintinnus lagenula Claparède et Lachmann 1858 p. 204, pl. 8 figs. 10, 11. Codonella pusilla Cleve 1900 d, p. 970; C. pusilla var. inornata Brandt 1906/7 p. 120, pl. 20 figs. 7, 8.

Sts. 80 (in Salpæ, frequent), 175 (350 m. wire, very scarce; 1150 m. wire, singly), 206 (1945 m. wire, singly), Gibraltar (singly).

Lorica beautifully urn-shaped, oval to roundish, with a wide, "annulated" collar. The latter slightly dilated at the mouth, then somewhat narrowing, then again dilated and almost evenly passing over into lorica proper, as to shape, but distinctly offset from it through a more or less conspicuous border line. Lorica proper oval to broadly oval or roundish, below rounded, but frequently with oblique lateral outlines, showing a faintly marked pointing of the lower portion. Structure of lorica proper very characteristic, consisting of proportionately large and strong-walled, regularly hexagonal or roundish "secondary" meshes or "prismatic elements", in a single layer between the approximated lamellæ. In the middle of

the meshes a very fine dot or pore may be seen (as very frequently in a similar structure in many other microscopic organisms, e. g. diatoms and peridinians). Collar much more pallid and thin-walled, showing up to seven "annuli", the upper 3 to 4 being very narrow (low); structure only the very fine "primary" one, but sometimes — particularly on the lowermost "annulus" — also one or two, rarely more, circular or transversely oval "windows". "Foreign bodies" are generally wanting or rare (and small).

Length of well developed specimens about 50 μ, diameter of mouth = 20 μ—23 μ, rarely but 17 μ; maximum diameter (about in the middle of lorica proper) 32 μ—40 μ, meshes about $2^1/_2$ μ—3 μ.

This tiny species, undoubtedly that of Claparède and Lachmann, is apparently widely distributed and considerably varying; is, however, so small that it will certainly as a rule slip through the finest nets. It is therefore very probably much more frequent in the Mediterranean, than the few records above show. It is not rare on the west coast of Norway, and was already well described and figured by Claparède and Lachmann. Their figures (quoted) give an oblique view, on account of which they show the length, in proportion to the width, too short. The authors mentioned state the length as 30 μ, which is rather low; their fig. 11, at the magnification quoted, also gives a somewhat greater length.

To this species apparently belongs *Codonella ecaudata* var. *brasiliensis* Brandt 1906/7 p. 119, pl. 13, figs. 4, 6, pl. 20 fig. 9, probably synonymous with my *Codonella lagenula* var. *ovata* (Jörgensen 1899 p. 27, 1905 pl. XVIII fig. 117, a figure, not particularly good). This latter variety of the present species is larger than the main species and is much more closely covered by "foreign bodies", concealing the characteristic structure of the outer lamella. Otherwise it apparently answers to the present species; it was found to have two roundish oval macronuclei.

The main species is distributed from the Bay of Biscay and the sea west of the same as far as the New Foundland Bank, the south point of Greenland and the southern region of Davis Straits, thence to Iceland, Scotland, the North Sea and the west coast of Norway, and in the north as far as Barents Sea. Cleve reports it from 39° S 10° W to 42° S 3° W in the Southern Atlantic (Cleve 1901 a). The var. *ovata* also at the Lofoten; if synonymous with *Codonella ecaudata* var. *brasiliensis* it was taken near Pernambuco and at about 30° S 43° W far off the southern coast of Brazil (Lohmann 1920). Some of the localities given by Cleve for *Codonella pusilla* are situated west of the south-west coast of Ireland; a "*Codonella ecaudata* (?)" is recorded from the area of the Irish seasonal investigations of the sea (May 1910), probably the same species which Lohmann reports from the Channel in May 1911 as *C. ecaudata var. brasiliensis.*

5. CODONELLOPSIS (?) TUBERCULATA? (Dad.) (Fig. 114 p. 99).

Amphorella tuberculata? Daday 1887 p. 541, pl. 18 fig. 20.

Lorica broadly oval or roundish, with a low, simple or "annulated" (?) collar, strongly offset from lorica proper. The outline of the latter angular at the end (which is indistinctly pointed), at the sides very slightly, though regularly, wavy. The collar distinctly limited from the lorica proper, wider at the base, at the mouth erect or somewhat curved outwards. "Annuli" of collar, if present at all, very indistinct; at the base, where — eventually — the lowermost turn of the helicoidal band should be, sometimes one or very few transversely oval "windows", as in the preceding species, are seen. Wall of lorica apparently as a rule with distinct lamellæ, in a thin-walled specimen these latter were, however, incompletely separated. The outer surface of the lorica proper appears more or less regularly dinted; in one case faintly marked, rather distant, equal-sized circles were seen (in front). The outside of lorica proper also shows a very fine and indistinct reticulation, more plainly visible in thin-walled, less opaque specimens. Finally, some few, very distant and irregular, agglutinated particles may occur, similar to the smaller ones of *Tintinnopsis.*

I saw only three specimens from st. 172, 200 m.—50 m. (Black Sea).

III. BRIEF SURVEY OF THE OCCURRENCE OF THE SPECIES

The Tintinnid-fauna of the Mediterranean is remarkable for its abundance of species combined with a general scarcity of individuals, as in the two other groups of protists, the Ceratia and the Dinophysiaceae, which I have previously treated from the material of the "Thor" (conf. this Report vol. II J. 1 a. J. 2). Only very few species occurred in any great number and this as a rule only occasionally, with the exception, however, of *Rhabdonella spiralis* which was mostly very numerous or predominant and sometimes occurred in huge quantities.

For comparison with the Ceratia I have counted the total number of individuals examined in that group and the present, and give here the result in tenths of the total number (Ceratia+Tintinnids). These numbers do not claim any great accuracy — an even mixing being also difficult to obtain with organisms so dissimilar, heavy or light, with or without adaptations for drifting — but may be of some use in giving a safer idea of the occurrence on the whole than a mere estimate.

For the winter cruise I found the following figures:

sts.	10	11	P. A.	12	14	15	16	Naup.	18	20	T.	Nap.
Tint., tenths	6	4	2	3	6	5	2	5	3	2	2	1
sts.	23	24	25	26	27	28	29	31	33	35	36	38
Tint., tenths	4	5	3	4	3	6	5	6	5	3	3	5
sts.	39	40	42	G.	45	46	50	53	55	58	59	60
Tint., tenths	3	2	1	3	1	0	3	1	2	4	1	3

The Tintinnids were at this season, compared with the Ceratia, relatively numerous, at the surface often more numerous than the Ceratia, particularly in the Ligurian, the Tyrrhenian and the Jonian Seas, average number 4 in each, lesser in the Alboran and the Balearic, average number for each 2. For the Bay of Cadiz the corresponding figure was 3.

The numbers for surface samples in the Western Mediterranean during the route outwards of the summer cruise were found to be:

sts.	98	99	100	101	102	103	106	108	109	110	111	112	113
	1	1	0	0	0	0	0	0	1	0	0	0	1
sts.	114	115	116	117	118	119	120	122	123	125	G.	126	127
	8	9	9	6	9	2	6	4	0	1	0	0	2
sts.	128	129	131	132	133	134	135	T.	136	137	138	139	
	4	2	3	1	1	2	1	0	0	5	3	2	

and the corresponding figures for the return journey:

sts.	194	195	196	197	N.	198	199	200	202	203	204	205	206	208	209	210	211
	3	0	1	2	9	1	2	3	2	6	6	1	1	1	0	4	5
sts.	Barc.	212	213	215	216	217	218	219	220	221	224	225	226	227	228	Gibr.	
	4	1	0	2	2	1	2	0	1	0	0	0	0	0	1	0	

The average numbers for the different seas are:

Alboran Sea in June 0, in September 0; Balearic in June 5 (0 to 9), in July, south-eastern region, 2 (0—5), in September 1 (0—2); Catalonian Sea (August) 2 (0—5), Ligurian (July) 1 (0—4), Tyrrhenian in July 2 (0—4), in August (return journey) 3 (0—9).

The figures for samples from deeper levels are essentially higher:

sts.	126			128	129			132	
depth.	200 —100 m.	500 —120 m.	275 m. w.	100 —0 m.	80 —0 m.	600 —0 m.	1100 —0 m.	600 —195 m.	1090 —57 m.
Tint	4	8	3	4	1	4	5	10	10

sts.	134				194	199			204
depth.	75 —0 m.	125 —75 m.	200 —125 m.	350 —185 m.	1145 m. w.	30 —0 m.	200 —80 m.	945 m. w.	945 m. w.
Tint	4	6	7	10	5	3	7	6	8

sts.	206	209					223	228
depth.	1945 m. w.	80 —33 m.	200 —85 m.	1000 —200 m.	945 m. w.	1945 m. w.	1950 m. w.	1145 m. w.
Tint	5	3	8	10	6	7	3	1

This fact, that the relative number of Tintinnids increases towards the depth, is partly owing to an absolute increase to a certain depth, varying in different species, partly to the decrease and final disappearance of the Ceratia.

Striking are the low averages for the Atlantic Current: in June 0, in September 1; outside the Straits of Gibraltar the corresponding average numbers for the Tintinnids were 2 (0—6) and 4 (2—5).

For the Eastern Mediterranean I found the following numbers for the surface samples:

sts.	140	143	145	147	148	151	152	153	154	155	156	158	160	161
Tint	4	0	3	1	0	0	3	5	1	1	3	2	2	7
sts.	162	163	164	165	167	168	169	170	K.	171	172	173	174	175
Tint	2	4	1	1	0	0	0	0	1	0	0	1	1	0
sts	178	179	180	181	182	183	184	185	186	187	189	190	192	
Tint	0	1	1	5	2	6	1	2	4	2	1	2	4	

This gives an average for the Ionian Sea in July of 4 (3—5), in August (during the return voyage in the northern region) 2 (1—4), for the Levant (August) 2 (1—3), for the Ægean Sea 3 (0—7), in the Dardanelles 0, in the Marmora 0 (0—1), in the Bosphorus 1 (0—1), and in the Black Sea 1 (0—1).

In deeper levels the Tintinnids are again more dominating:

sts.	152		156		160				163
depth	250 m. w.	950 m. w.	250 m. w.	950 m. w.	30 —0 m.	100 —30 m.	200 —100 m.	1000 —200 m.	80 —0 m.
Tint.	5	6	4	8	1	3	7	9	3

sts.	170				172			175		
depth	20 —0 m.	80 —20 m.	200 —85 m.	1000 —195 m.	17 —0 m.	50 —17 m.	200 —51 m.	30 —0 m.	350 m. w.	1150 m. w.
Tint	0	1	4	10	0	1	1	0	1	1

sts	182	184	186		187			189	192	
depth	545 m. w.	945 m. w.	245 m. w.	1145 m. w.	25 —0 m.	190 —100 m.	945 m. w.	945 m. w.	545 m. w.	
Tint	5	6	5	5	2	5	4	6	5	

In the Black Sea Region (sts. 168—178) the Tintinnids are generally scarce, the Ceratia numerous, except in very deep layers.

Of special interest is the question of immigration into the Mediterranean through the Straits of Gibraltar; from the material of the "Thor" such an immigration should be expected to be traceable for the months of February and January, June and September (at least).

The very low figures above stated for the relative frequency of the Tintinnids, on the whole, in the region of the Atlantic Current in June and September, 0—1 and 0—2, on an average 0 and 1, compared with the higher values for the Bay of Cadiz, 2 and 4, show that the summer, or at all events June and September, cannot be a favourable season for an invasion into the Mediterranean of the Tintinnids in general.

It should, however, be remembered that the data available do not definitely settle the question (of immigration). For the month of June they only show the state of things for the surface: no surface species outside the Straits appears as a surface species inside the same in greater numbers at a series of stations in the Atlantic Current. There are, however, other possibilities. Lohmann (1920 p. 228), on his voyage with the "Deutschland" (1911) found that the Tintinnids in the cooler waters were more numerous at the surface, but in the warmer had a second, and equally high maximum of frequency at 100 m. below the surface, or even the absolute maximum there, in the latter case increasing in numbers right from the surface. In the Mediterranean, on the whole, the Tintinnids were in summer remarkably numerous in deeper layers, or, properly speaking, remarkably scarce at the surface, many species being found there only occasionally or not at all. It is therefore possible that a species of these, relatively very rapidly moving animalcules, may pass over into deeper layers inside the Straits and therefore escape detection. On the other hand, as the Atlantic Current reaches downwards to a certain depth, a species may have entered the Mediterranean below the surface.

Applying these views at the observations for June — the last mentioned case excepted — there should be a possibility for immigration into the Mediterranean through the Straits of Gibraltar in the following cases:

1. when the species is present outside the Straits, as well as inside, in the Atlantic Current,
2. when the species is present outside the Straits, but does not appear at the surface inside them, or only just inside, being, however, frequent at deeper levels farther east,
3. when the species is absent outside the Straits, but appears somewhere in the Atlantic Current inside them.

The first case shows an obvious invasion when the species in question is found at a series of stations, outside as well as inside the Straits, but this seems to be a rather rare case among the Tintinnids. Still rarer are cases of an obvious increase in frequency inside the Straits in the Atlantic Current; there exists, however, here — as in the Ceratia — a somewhat similar, though very rare, case, when a species (*Rhabdonella spiralis*) in the western region of the Atlantic Current decreases strongly in numbers, apparently struggling for life, but finally, at the eastern end of the current, swells up to great masses, mostly consisting of a modified form (*Rhabdonella spiralis α*), now taking the lead at the surface, whilst the invading form (var. *elongata* or near to it) passes over to deeper levels.

In June, case 1. above only gives two or three species entering the Mediterranean from the Atlantic, *Tintinnus fraknóii*, decreasing in numbers, *Xystonella acus* and perhaps *Amphorella steenstrupi*, scarce. Case 2. seems to be applicable to several of the more frequent Mediterranean species: *Codonella galea*, frequent in the Bay of Cadiz and present at three stations subsequent just inside the Straits, but then suddenly vanishing from the surface, probably passing over to deeper layers where it is frequent farther in, *Dictyocysta elegans*, *D. lepida*, *Undella claparèdei*, *U. hyalina* and perhaps *Cyttarocylis cassis*, *Climacocylis scalaria*, *Codonella nationalis* and *C. perforata*. Case 3. might further only give *Petalotricha ampulla*, perhaps occasionally entering the Mediterranean from the west.

From September we have but scanty material for judgment on the same question, but now there are also two deep-water samples, from sts. 231 and 228, 1145 m. wire. According to Dr. SCHMIDT these "wire-samples" should chiefly correspond to a depth half as great as the length of wire, i. e. in this case below the Atlantic Current. On hauling in, some species from this current may be caught (singly); otherwise these two deep-water samples should only contain emigrating species. This latter case, the same species present in both deep-water samples, is not very rare, but may perhaps apply to only empty loricae or sunken dead specimens. At this season there is an obvious immigration into the Mediterranean of *Rhabdonella spiralis* (var.) *elongata*, though in decreasing numbers, of *Undella hyalina* in increasing numbers, further of *Tintinnus fraknóii*, *Climacocylis scalaria* and perhaps of *Amphorella quadrilineata*. Besides, *Dictyocysta elegans* and *Favella azorica* are occurring singly inside the Straits in the Atlantic Current and may have entered from the Bay of Cadiz in the way above suggested.

In winter (February) the average number for the Tintinnids is 2 (tenths) inside the Straits and 3 outside, the conditions for an immigration into the Mediterranean accordingly better. No winter samples from deeper levels being at hand, we have to judge from the surface samples alone. The Mediterranean stations in the Atlantic Current are, according to the hydrographical data, sts. 60, 59, 46 and 45; less markedly Atlantic are sts. 58, 53 and 50. The following species seem to enter through the Straits: *Codonella galea*, abundant at st. 53, *Dictyocysta lepida*, *Undella claparèdei angustior*, *U. hyalina* in increasing numbers; *Cyttarocylis eucecryphalus*, *Climacocylis scalaria*, *Xystonella acus* and *Dictyocysta mitra* vanish from the surface a little way inside the Straits. *Petalotricha ampulla* was abundant outside and just inside the Straits, but vanished from the surface a short distance farther in. A few other species, as *Undella aculeata* and *U. marsupialis*, were present singly at a couple of stations outside the Straits, but disappeared at a short distance inside them.

As already suggested in my papers on the *Ceratia* and *Dinophysiaceae* of the "Thor", the best seasons for a successful immigration of species through the Straits of Gibraltar into the Mediterranean might be late autumn and perhaps some time in spring, when there may be no noticeable difference in temperature between the Atlantic Current and the surrounding water in the Western Mediterranean.

The character of the Mediterranean Tintinnid fauna is, on the whole, that of a marked southerly or warm-water fauna, consisting mainly of warm-temperate or even subtropical, perhaps also tropical, forms. This is in full accordance with the characters of the *Ceratia* and *Dinophysiaceae*. In order to obtain more accurate statements, which later may be supplemented and corrected, I will try to introduce special provisional designations, dividing the species of the material into five geographical groups: tropical

species, not or scarcely reaching the Azores (from the south), subtropical, liberally reaching the Azores and partly the sea west of Portugal, occasionally to the southern region of the Bay of Biscay, warm-temperate, reaching the Channel and Ireland, in the open Atlantic about to 50° à 53° N., exceptionally (in late autumn) farther, cold-temperate, reaching the south coast of Iceland and the coast of Nordland (Norway), and subarctic, reaching past Iceland, to the northern regions of the Norwegian Sea and the regions of the Barents Sea and other northern regions where properly arctic conditions do not yet prevail. These divisions apply to the oceanic species, not to the neritic, and only to the distribution on the northern hemisphere; if necessary to avoid confusion they may be supplied with the prefix boreo-, in contradistinction to austro- for the southern hemisphere.

I. Group (B_2) of oceanic boreo-subtropical species.

Climacocylis scalaria, Codonella amphorella, C. cistellula, C. nationalis, C. perforata, Coxliella fasciata, C. laciniosa, Cyttarocylis cassis and *eucecryphalus, Epiplocylis acuminata, E. undella, Rhabdonella elegans, Undella aculeata, U. hyalina, U. marsupialis, Xystonella treforti, Xystonellopsis cymatica.*

The species of this group are rarely present in greater numbers, all present also in winter, and do not enter the Sea of Marmora. Of the 17 species above the following 9 are in summer in the Eastern Mediterranean only noted for deeper levels: *Climacocylis scalaria, Codonella amphorella, C. cistellula, Cyttarocylis cassis* and *eucecryphalus, Epiplocylis acuminata, Undella aculeata, U. hyalina* and *U. marsupialis,* whilst all 17 in summer are found almost exclusively below the surface.

To this same group of markedly warm-water species also many of the other species certainly belong, their distribution being as yet only imperfectly known.

II. Group (B_3) of oceanic warm-temperate species.

To this group probably belong almost all the rest of the Tintinnids in the material of the "Thor"; their distribution being, however, still mostly uncertain or very little known, I will here provisionally only list the following species:

Amphorella ganymedes(?), *Codonella galea, Codonellopsis orthoceras, Dictyocysta mitra, Petalotricha ampulla, Protorhabdonella simplex, Rhabdonella spiralis, Tintinnus fraknóii, Undella claparèdei, Xystonella acus*(?).

These species are less markedly warm-water species; they are partly or sometimes occurring in great numbers and include the more dominating species of the Mediterranean. Some of them extend into the Sea of Marmora (*Petalotricha ampulla* var., *Tintinnus fraknóii, Undella claparèdei*).

III. Group (B_4) of oceanic cold-temperate species.

Such species are rare and nearly always scarce in the material of the "Thor". They are mostly true northern (forms or) species, more or less closely allied to corresponding southern forms (or species): *Amphorella quadrilineata,* the main species, *A. steenstrupi,* the main species(?), *Undella caudata,* in contradistinction to *U. lohmanni* and *U. aculeata.*

Some are northern forms of southern species:

var. *tubulosus* av *Tintinnus lusus-undae,* and *Dictyocysta elegans* var. *speciosa* (var. *disticha* Jörg. 1899 p. p.) which may be a northern or cold-temperate form of the more southerly (or less northerly) distributed *D. lepida.*

To this group also seems to belong *Codonellopsis lagenula* which, however, perhaps is a neritic species.

Nearly all species of this group extend into the Sea of Marmora.

IV. Group (B_1) of properly tropical species.

Such species, of a true tropical character, may perhaps occasionally enter the Mediterranean from the west, chiefly in winter?, and keep alive for some months, apparently by preference in deeper layers of the Eastern Mediterranean. Here may belong the following species:

Undella collaria and *tricollaria*, *Xystonellopsis paradoxa* and perhaps *Dictyocysta mülleri*. By the imperfectly known distribution it may later be proved that these species properly belong to the subtropical group. They are all — only the last species excepted — present (in the Mediterranean) in winter at the surface, and in summer only known from deeper layers of the Eastern Mediterranean. *Dictyocysta mülleri* is not noted for the winter (may have been included in *D. elegans*) and occurs also at st. 209 in deeper layers (besides in the Eastern Mediterranean).

V. Group (B_5) of oceanic subarctic species, in part or wholly comprising the so-called boreal species (Cleve, Gran).

Species of this group scarcely occur in the Mediterranean. Here belong the main species of *Tintinnus acuminatus* (including var. *secatus* Bdt.), certain forms of *Dictyocysta elegans* (probably the main species), as well as *Favella denticulata* and the genus *Ptychocylis*. They extend southwards about to the northern limit of the warm-temperate species (group B_3).

The neritic species were in the material of the "Thor" as a rule very scarce, only very few plankton catches being made at coast stations. Here belong the species of *Tintinnopsis* and *Stenosemella*, *Favella serrata*, *F. adriatica*(?), *F. ehrenbergi* and *márkusovszkyi*, *Coxliella helix*, *Helicostomella subulata* and *Metacylis mediterranea*. These species are generally or frequently very widely distributed, over both colder and warmer regions, a remarkable fact, as, a priori, one might expect the coast forms to be developed into many more or less local forms or species, in contradistinction to the oceanic. In fact, the state of things seems rather to be the inverse, the oceanic genera are highly differentiated into species, and these generally into forms, the neritic are, as a rule, remarkably uniform. An exception is the genus *Tintinnopsis*, in which the number of species is very great; also here, however, many species appear to have a remarkably wide area of distribution, from subarctic, or in part even arctic, localities to subtropical or tropical. The characterization of the species of this genus is, however, more or less difficult, and requires great experience. The species of the Mediterranean still await much better elucidation.

Of special interest, compared with the oceanical groups, is the fact that the neritic species, more closely corresponding to the northern oceanic forms, answering roughly to group B_4, were by no means rare in the Mediterranean, sometimes even numerous as to individuals. Here belong *Tintinnopsis beroidea* Entz, the species of *Stenosemella*, *Favella ehrenbergi* var. *helgolandica* and var. *claparèdei*, *F. serrata*, *Coxliella helix* and *Metacylis mediterranea*. There are also others which either do not extend so far to the north, as *Favella adriatica*, or are confined to the Mediterranean, as *Favella markusovszkyi*(?); or are otherwise only known from warmer localities, as *Tintinnopsis compressa*, *T. radix*, *T. angulata* and allied species.

There still remains a rather numerous group of species, as yet only known from the Mediterranean or, most of them, here above established as new species. These are in part true warm-water species, the northern waters being rather well explored as regards Tintinnids, in part very small forms, the distribution of which is as yet quite unknown on account of their slipping through the plankton nets commonly used.

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